

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

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Abstract

Free-floating carsharing is emerging in cities around the world. Based on a survey of car2go (n=95) and DriveNow users (n=737) in Copenhagen, followed by in-depth interviews with selected car2go users (n=12), this paper focuses on the practices and motives related to the use of a free-floating carsharing service in a city with a distinct cycling culture. Data were collected within the first year of the car2go and DriveNow launch. Like in other studies, users were mainly young, highly educated males, living in the city centre. However, different from other studies, they were predominantly daily cyclists. A key finding was that car2go did not substitute or compete with primary transport modes, especially since car2go (as well as DriveNow) was only used to a small degree for commuting. Based on in-depth interviews, different motives and user patterns could be identified depending on car ownership status. Non-car owners primarily used car2go for leisure or business trips and for transporting goods, whereas car owners mostly used car2go to avoid driving their private car in the city. For both groups, car2go could not fully cover their car needs. The withdrawal of car2go from Copenhagen after 17 months of operation is reflected based on the identified mobility patterns and user experiences.

Sammenfatning

Bybiler (delebiler uden fast stamplads) har været i vækst i verdens storbyer. I dette paper fokuserer vi på adfærd og motiver knyttet til brug af bybiler i København. Til forskel fra mange andre byer med bybiler er København karakteriseret ved en høj cykelandel og en cykelkultur, hvorfor der her kan være andre effekter af bybiler. Datagrundlaget er undersøgelser blandt car2go brugere (n=95) og DriveNow brugere (n=737), samt opfølgende kvalitative interviews med udvalgte car2go brugere (n=12). Undersøgelserne blev gennemført inden for det første år efter åbningen af hhv. car2go og DriveNow i København. I lighed med bybilbrugere i andre lande/byer var brugerne i København især yngre, højt uddannede mænd med bopæl i de centrale dele af Storkøbenhavn. Til forskel fra bybilbrugere i andre lande var de fleste københavnske brugere også hverdags-cyklister. Resultaterne peger på at car2go i København ikke erstattede eller konkurrerede væsentligt med andre transportmidler. Dette skyldes bl.a. at car2go (eller DriveNow) ikke anvendes til daglige ture som pendling. De kvalitative interviews pegede på forskelle i brugsmønstre og adfærd afhængigt af bilejerskab.

Ikke-bilejere anvendte især car2go til fritids eller 'business'-ture og til transport af varer. Blandt bilejere blev car2go især anvendt til at undgå at medbringe egen bil på ture til centrum. Både ikke-bilejere og bilejere fandt dog at car2go havde begrænsninger i forhold til at dække deres behov. Diskussionen behandler bl.a. brugsmønstre og brugeroplevelse som en del af baggrunden for at car2go efter 17 måneders drift valgte at afvikle sine aktiviteter i København.

1. Introduction

In Europe, carsharing has been known as a niche product for more than 25 years. However, in recent years, membership rates have grown considerably, probably as part of a trend in sharing economies driven by rapid technological developments: While early carsharing systems had complex procedures for booking, billing, picking up and returning cars, modern systems offer car booking via an app and billing occurs automatically (e.g., Kopp, Gerike, & Axhausen, 2015). Free-floating carsharing systems have been launched in cities around the world supplementing traditional station-based carsharing systems (Heilig, Mallig, Schröder, Kagerbauer, & Vortisch, 2018; Kortum, Schönduwe, Stolte, & Bock, 2016). Here, the car does not have to be returned to the place where it was picked up but can be parked freely within a defined (city) zone (Shaheen, Chan, & Micheaux, 2015).

Free-floating systems are often developed and provided by the car industry (e.g., car2go by Daimler, DriveNow by BMW¹) and can be regarded as a response to a decreasing number of car owners in larger cities. In many Western countries, young people's licensing rates are reduced (Delbosc & Currie, 2013; Hjorthol, 2016) or delayed (Coogan et al., 2017; Rérat, 2018) and those who are licensed, drive less (Kuhnimhof et al., 2012). Yet, also contradictory trends have been found, including strong intentions to obtain a licence in pre-licensed adolescents in Denmark (Møller, Haustein, & Bohlbro, 2018) and continuously increasing licensing rates among young people in the Netherlands (Delbosc & Currie, 2013) – both countries with a distinct cycling culture (e.g., Carstensen & Ebert, 2012; Haustein & Nielsen, 2016; Haustein, Kroesen, & Mulalic, 2020).

First studies on free-floating carsharing schemes have examined user groups and travel patterns of free-floating carsharers (e.g., Becker et al., 2017; Kopp et al., 2015; Martin & Shaheen, 2011) and estimated effects on mode choice and car ownership (e.g., Becker et al., 2018). However, none of these studies was conducted in a distinct cycling culture like Denmark, where practices and effects may be different. In addition, these studies are solely based on quantitative data, which offer limited insight into users' motives and considerations, which may be relevant to understand why the service is working in a specific mobility culture or not. On this background, this study examines the characteristics and mobility patterns of the first free-floating carsharers in Denmark, including car ownership, transport patterns, use and rationales for use of free-floating carsharing. Analysis based on quantitative data is further enriched by results from qualitative interviews with selected participants enabling in-depth analysis of use patterns and users' assessment of carsharing as part of their mobility behaviour.

The remainder of this paper is structured as follows. Section 2 provides the empirical background of this paper with an overview on carsharing user motivations, mobility patterns and socio-demographic profiles as identified in the literature as well as a description of the study site. Section 3 introduces the data and methods of analysis. Section 4 presents the results of the quantitative (Section 4.1.) and qualitative data (Section 4.2). Section 5 discusses the withdrawal of car2go in Copenhagen on the background of members' general mobility patterns, their user motivation and actual use of car2go.

2. Background

2.1 Carsharing motivations

An important question in relation to carsharing development is what motivates people to share a car and to what extent these motivations differ relative to the region, time and the carsharing system (free-floating vs. station-based). Based on in-depth interviews with carsharing users, a North American study identified four

¹ In February 2019, car2go and DriveNow merged into a joint venture and named the new free-floating carservice SHARE NOW (Arriva 2019).

motivational patterns underlying carsharing usage (Schaefer 2013): (1) value-seeking, i.e. the psychosocial consequence of saving money (and using it for other things); (2) convenience with regard to saving time and effort, e.g. better parking conditions or avoiding responsibility for car maintenance; (3) lifestyle: symbolic-affective motivation where membership is an expression of a particular lifestyle that differs from non-members and is identified by other members and, lastly, (4) environmental motives.

Danish surveys based on traditional carsharing (Nielsen, 2005; Nielsen et al., 2014) found strong support for the utilitarian motive of being more flexible than without having a car but with limited costs and obligations as compared to car owning. This appeared to be the main motivational basis for joining carsharing. Environmental aspects, as well as better health (through more cycling), are often mentioned as an advantage but they seldom constitute the main motive. In an earlier Danish study in which carsharing members were compared with non-members, no significant differences were found in terms of the environmental awareness of the two groups (Narre, 1999). In contrast, in international studies (potential) carsharing members are often identified as people with higher environmental awareness and a more functional relation towards private cars (e.g. Burkhardt & Millard-Ball, 2006; Grischkat, Hunecke, Böhler, & Haustein 2014). The latter also seems to be more common in today's younger generation (Heikkilä, 2014; Kuhnimhof, Armoogum, et al., 2012; Kuhnimhof, Buehler, et al., 2012, Rérat, 2018; Monteiro et al., 2021), though in a sample of Danish adolescents, the symbolic value of the car seemed quite pronounced, even among environmentalists (Møller et al., 2018). Generation Y has also been described as putting more emphasis on "experiencing" rather than on "having" (Hopkins, 2017), which may contribute to carsharing expansion. In particular the flexibility provided by free-floating schemes as compared to station-based carsharing may attract new segments of users. Although carsharing members in the 1990s differed from non-members by considering flexibility and time requirements as being less important (Steininger, Wogl, & Zettl, 1996), one can imagine that the technology-based free-floating concept has made carsharing more attractive for people with a strong requirement for flexibility and interest in innovation (e.g., Kent & Dowling, 2013).

2.2 Socio-economic profiles and mobility patterns of free-floating carsharers

International studies show that users of free-floating carsharing differ from users of traditional station-based carsharing services. Young men are overrepresented among free-floating carsharers, which may be due to the emphasis on technology. Yet, the gender gap is decreasing: In 2011 only 10% of DriveNow users were women but the share increased to 30% in 2014 (Schleufe, 2014). Similarly, in Switzerland (Basel) in 2015, 70% of free-floating carsharers were men, as compared to 60% of station-based carsharers (Becker et al., 2017). In Germany, 60% of the free-floating carsharers are younger than 36 years old (Firkorn & Müller, 2012; Kopp et al., 2015), in Switzerland it is half of the members (Becker et al., 2017). Carsharing members of both free-floating and station-based schemes are generally found to have a higher education than non-members (e.g., Becker et al., 2017; Kopp et al., 2015; Martin & Shaheen, 2011).

Apart from their differing socio-economic profiles, carsharers (free-floating as well as station-based carsharers) have different travel patterns than non-members: Comparing members and non-members in Berlin and Munich in the same age group, free-floating carsharers were found to make more trips and to exhibit more intermodal and multimodal transport habits (Kopp et al., 2015). In addition, they were found to cycle more and to drive less. However, it is likely that these differences already existed before their membership of the carsharing scheme. The short and long-term effects of free-floating carsharing systems are still under examination. The question as to whether free-floating carsharing primarily enables people to maintain a car-free life or can rather be considered as a step towards future car ownership is addressed in ongoing longitudinal studies (e.g. Zimmer, Hülsman, & Götz, 2014). Results from Switzerland indicate that public transport and non-motorised modes are used less after joining free-floating carsharing, while the opposite effect is found for station-based car-sharing (Becker et al., 2017). According to Becker et al. (2018), car ownership is also reduced by free-floating carsharing, though to a lesser extent than by station-based carsharing, while Haustein and Jensen (2020) found no significant effect of free-floating carsharing, when controlling for background variables.

Regarding short-term effects it is also of interest to establish whether previous trips are just being replaced or whether additional trips are conducted. For trip replacements, it is additionally relevant to know with which transport modes the previous trips were conducted.

A matter of particular concern is whether free-floating carsharing increases the number of car trips and vehicle kilometres driven, rather than reducing them, as it has been demonstrated for station-based carsharing (e.g., Martin & Shaheen, 2010; Rydén & Morin, 2005; Steininger et al., 1996). According to Becker et al. (2017) about the same share of users indicate to have increased and decreased their car usage. Especially for local city governments this is an important concern because they are challenged with regards to whether to regulate or support the concept.

2.3 The present study

In Denmark, the first free-floating carsharing system was introduced by car2go in September 2014 within a 44 sq. km 'Home-Area' stretching 4-5 km outwards from the city centre of Copenhagen. The following year, a competing service was introduced when DriveNow launched 400 electric vehicles. With 28% cycling trips, 31% car trips, 21% public transport, and 20% walking (City of Copenhagen 2018), the modal split for all trips with origin or destination in the City of Copenhagen is somewhat unusual for a European capital. Except for the Netherlands cycling mode shares are lower and public transport or walking often higher in other European capitals depending on the local mobility culture (Goletz et al., 2020). The area covered by the city of Copenhagen is relatively small and the local city government expressed concerns that free-floating car trips would compete with trips by bicycle or public transport, which are transport modes they are prioritising. However, after 17 months of operation, car2go decided to withdraw from Copenhagen because they had not been able to achieve the critical mass of users considered necessary for a viable business due to the large amount of cycle trips and use of public transportation compared to the other cities car2go operate in (car2go 2016). In this study, the mobility patterns, user motives and actual use of car2go is examined and discussed as a potential reason for the withdraw of car2go from the cycling city of Copenhagen.

3. Method

This study follows a mixed methods approach combining quantitative and qualitative data, or data from an online survey and in-depth interviews, respectively. Mayring (2001) distinguishes four different ways to combine qualitative and quantitative data from a study design perspective. We used a consolidation approach, meaning that the results of the quantitative study were deepened by the qualitative interviews (e.g., Haustein & Hunecke, 2007). The usefulness of qualitative research to understand motives for the choice of specific transport modes has earlier been demonstrated in Beirão and Cabral (2007), Guiver (2007) and Jensen (1999), for example. Recently, it has also been used to analyse the impact on mobility behaviour and car ownership of station-based carsharing (Jain et al., 2020).

3.1 Procedure and participants

3.1.1 Online survey

Facebook is the most used social networking site in Denmark with 67% of the Danish population between the ages 16 and 89 having an active Facebook profile. Moreover, both genders, and all ages from 13 and upward, are well represented (Statistics Denmark, 2014; Nielsen, 2013). Car2go's official Facebook page in Denmark has been active since September 2014. It has provided car2go with a direct line of communication to people following their page by posting images, flyers and text (in Facebook terms: posts) and these posts are spread through the social media site to acquaintances of the followers (in Facebook terms: friends) when people either like or comment on them. As it was not possible to collaborate with car2go on the survey and acquire membership information directly from them, Facebook was assumed to be a potentially effective method to reach members of car2go in Copenhagen. Since car2go's service and system is only accessible online, all members would need Internet access thus limiting the bias that might arise from contacting car2go users through Facebook rather than more conventional and direct modes of access. Car2go followers were contacted via a Facebook message in March 2015 and asked to fill out an online survey.

The total number of contacted followers was 1,096 of which 193 responded, resulting in a response rate of 18%. Of the 193 respondents, 136 turned out to be members of car2go but of these 30 had never actively

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

used their membership. After removing 11 cases of unfinished fill-ins, the cleaned sample used in this study consisted of 95 participants².

For comparison and validation, the car2go users are compared to respondents from the Danish National travel survey (TU) as well as respondents from a later survey among the users of the free-floating carsharing service DriveNow. The Danish National Travel Survey is based on a representative sample of the age group 10–84 that is interviewed regarding their travel activities on the previous day (Christiansen & Skougaard, 2015). The survey provides a detailed account of one day's travel activities including respondents trip-origins, destinations, travel modes and purposes. This paper uses survey data from 2007 to 2014 to represent car-owners, carless households and members of station-based carsharing offers – and comparing them with the results from the survey among car2go users. The travel survey additionally allows comparison of car2go trips with other trips within the home-area of car2go. Comparison with respondents from DriveNow users in Copenhagen, surveyed in March 2017, one and a half years after the launch of the service, is added when similar questions are available from the two surveys. Here, data were collected based on an online-survey that was sent out to DriveNow users in cooperation with DriveNow from 2017-2019. The included sample of the first survey wave consists of 737 active users (see Haustein & Jensen, 2020).

3.1.2. In-depth interviews

One barrier in the selection process of interview partners was that only 84 respondents had provided their contact information. Of these respondents, interviewees were selected based on their answers in the survey. Since the purpose of the interviews was to further examine car2go users' general transport pattern and how they used the system, a criterion in the selection process was that the respondents had used car2go more often than 'rarely' (n=49). As the system only had been offered in Copenhagen seven months at the time of the data collection it was important to reach users who were somewhat familiar with the system. Another criterion was that the 'daily' or 'weekly' transport mode should represent the dispersal in the survey results, meaning that a mixture of daily cyclists, car drivers, public transport users, and more multimodal members were chosen. Additionally, an age and gender distribution that reflected the survey results was aimed for. Following these selection criteria, 12 respondents were interviewed; four of these were women and eight were men, all aged between 23 and 39 years old. Two interviewers conducted the interviews in a five weeks period at a location chosen by the respondent and they lasted approximately 30 minutes (ranging from 17 to 35 minutes). The interviews were audio recorded, transcribed, and subsequently coded. Table 1 provides an overview on the personal characteristics of the interview partners.

Table 1: Socio-demographic profiles of free-floating carsharers that took part in the in-depth interviews.

Pseudonym	Age	Gen-der	Occupational status	Education	Distance: home-city centre	Car-owner	Commuting mode
Stein	27	M	Student	General upper secondary school	5 km	Yes	Car
Per	33	M	Full time employee	Vocational education and training	2.5 km	No	Bike or bike/train
Benjamin	25	M	Self-employed	Vocational bachelor education	3.5 km	No	Walk or bus
Frederik	26	M	Full time employee	Vocational bachelor education	3.5 km	No	Bike
Chris	25	M	Student	Master's programme	2.5 km	No	Bike

² For more details on the data collection, see Garrett and Nielsen (2015).

Garrett et al.

Danny	39	M	Full time employee	Master's programme	11 km	Yes	Car or bike
Michael	33	M	Full time employee	Primary school	5 km	Previous	Runs or train or bus or bike or motorcycle
Georg	34	M	Full time employee	Master's programme	4 km	Yes	Bike or train or car
Hannah	25	F	Student	Vocational bachelor education	4 km	No	Bike or train/metro
Yasmin	26	F	Full time employee	Vocational bachelor education	5.5 km	Previous	Bus or car2go
Mette	37	F	Job seeking	General upper secondary school	2.5 km	No	Bus
Louise	23	F	Student	General upper secondary school	3.5 km	No	Bike

3.2 Measures

3.2.1 Online survey

A standardised questionnaire was designed, and responses were collected via the online survey tool Survey Monkey. The survey included 22 questions and was split into five sections: (1) the last car2go trip; (2) general transport patterns; (3) car ownership status; (4) attitudes and norms related to travel mode choice and car2go; (5) socio-demographics. In the first part, respondents were asked to reveal the following information on their last car2go trip: trip length, trip duration (rental period), trip purpose, and the reason for choosing car2go. To state the trip purpose participants could select one or more of the following purposes: visiting friends/family, going to sports- or cultural events/activities, shopping, commuting to school or work, going to a meeting during working hours, going to the airport, and other purposes (to be specified). The answers were recoded into the following trip categories: leisure (visiting friends/family, sports-/cultural events/activities), shopping, business, commuting to school or work, trying out car2go, transporting goods, and other. The question of why participants chose car2go for that specific trip was also asked as a multiple response question with the categories, because (1) it was the easiest; (2) it was the fastest; (3) of the weather; (4) it was the cheapest; or (5) private transport mode was out of order. In addition, respondents were asked, which transport mode they would have chosen, if car2go was not available.

Following this section, respondents were asked about their transport patterns stating how often they used different modes of transport including car2go ("daily", "weekly", "monthly", "rarely", "never") and whether they were car owners or had access to a car. These questions were followed by nine attitudinal statements related to different influences on modal choice and the use of car2go (weather, social and environmental norms, busyness in everyday life, and general environmental awareness, see Figure 3). The formulation of these items was inspired by previous Danish questionnaires, which included questions on environmental attitudes in relation to transport (Olafsson et al., 2016; Nielsen, 2002; Vejdirektoratet, 1995). The answers were provided on a five-point scale ranging from "strongly agree" to "strongly disagree". Finally, respondents were asked to include the following socio-demographic details: age, gender, postcode, education level, and occupation.

3.2.2 In-depth interviews

Semi-structured face-to-face interviews were conducted based on an interview guide. The interview guide was developed to supplement the quantitative survey and therefore especially relied on concepts and discussions from past research into car-sharing and its effects. The guiding questions dealt with the motivation to join

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

car2go, social (subjective) norms (are friends using it?, what image does it have?), what needs the service covers, how it fits into the users' everyday life, and what kind of trips are conducted with the service (e.g., planned, spontaneous). In addition, users' general activity and mobility patterns before and after joining car2go were discussed as well as expected future mobility, including increasing or decreasing car use. Car owners were additionally asked whether the service had an influence on buying a car or not, whether the service covered similar or different mobility needs than the own car, what shortcomings the concept had in relation to the own car, and whether the users' mobility needs could be covered based on car2go alone without an own private car.

3.3 Analysis

Socio-demographic data, travel behaviour, and attitudes included in the online survey were analysed by descriptive statistics including means, absolute, and relative frequencies. In addition, Spearman's correlations were calculated to identify significant relations between car2go user frequency, transport patterns, attitudinal factors and socio-demographics. Only significant correlations above .3 are reported. Differences between car-owner and non-owners were tested for statistical significance by ANOVAs or U-tests depending on the scale of measurement.

The in-depth interviews were transcribed and then analysed by the two interviewers by thematic analysis (e.g., Brown & Clark, 2006). First, by getting familiar with the complete data by reading and re-reading the transcriptions and then by discussing recurring themes across the interviews. After a process of refining the specifics of each theme, five themes were finally defined; (1) the type of trips car2go was used for, (2) reasons for disposing a private car in the future, (3) limitations of car2go, (4) environmental awareness, and (5) attitudes towards other transport modes such as station-based carsharing and public transport. The interviews were thematically coded, and this was done jointly by the interviewers in a consensus-oriented process.

The analyses provided a deeper understanding of the survey results and uncovered how members differed in their use of car2go depending on their car ownership status.

4. Results

This section first presents the results of the online survey (Section 4.1.) and then the results of the in-depth interviews (Section 4.2.), which elaborate on the survey results.

4.1 Survey results

4.1.1 Characteristics of free-floating members in Copenhagen

The socio-economic profiles of car2go users from the survey were compared to station-based carsharers and people with and without a car in the household in Copenhagen. The data of the three comparison groups are based on the Danish National Travel Survey (TU, Christiansen & Skougaard, 2015). In addition, the profiles were compared to first users of DriveNow (Haustein & Jensen, 2020), the free-floating carsharing service that followed to car2go. All profiles are presented in Table 2.

Table 2: Socio-demographic profile of free-floating carsharers in Copenhagen compared with station-based carsharers, people with and without a car in the household.

		TU			Survey among users	
		Household with car n=4893	Carless household n=4877	Carsharers (station-based) n=84	car2go n=95	DriveNow n=737
Age	18-30	19 %	44 %	11 %	60 %	20 %
	31-40	28 %	20 %	46 %	34 %	29 %
	41-50	21 %	11 %	27 %	6 %	28 %
	51-60	15 %	8 %	8 %	0 %	18 %
	>60	17 %	16 %	8 %	0 %	6 %
Gender	Male	53 %	46 %	60 %	79 %	81 %
Education	Long cycle higher education (>= 4 years)	29 %	20 %	53 %	31 %	33 %

Note. Source: the Danish National Travel Survey (TU) from 2007-2014 (18-84-year-old residents of Copenhagen or Frederiksberg municipalities), car2go survey data; DriveNow survey data (Haustein & Jensen, 2020).

The free-floating carsharers (car2go) were 19 to 46 years old with an average age of 30. Compared to station-based carsharers, the respondents were relatively young, because 60% were younger than 31. Similar results regarding age distribution of first free-floating members have been found in studies of free-floating systems in other cities (Firnkorn & Müller, 2012, Kopp et al., 2015). Gender was also unevenly distributed as 79% of respondents were male but this uneven gender distribution has also been seen in other free-floating carsharing studies (Firnkorn & Müller, 2012; Kopp et al., 2015) and is more extreme than for station-based carsharers. Regarding education, station-based carsharers stood out with the highest level of education, while free-floating carsharers were closer to people with a car in the household and carless households tended to the lowest level of education. The lower level of education of free-floating as compared to station-based carsharers can partly be explained by age difference and that 25% of free-floating users were still studying. 63% of car2go users were full-time employees and 5% were self-employed; part-time workers and job seekers were each about 3%. Firnkorn and Müller (2012) obtained similar findings in their study of car2go members in Ulm, Germany. Most respondents (96%) in this survey lived in Copenhagen where car2go was located.

4.1.2 Car2go trips and mode substitution

Respondents were asked about the duration and distance of their last trip with car2go. The average trip duration was 21 minutes and overall, 72% of the trips were less than 10 km and lasted less than 30 minutes. These numbers are similar to the results from a free-floating carsharing study in Munich and Berlin (Kopp et al., 2015). Figure 1 shows the distribution of travel distances by transport mode for trips starting and finishing within the car2go Home Area, based on TU data (for walking, cycling, public transport and car trips) and the survey results (for car2go trips). The distribution of car2go trips show that, the most common distance was five to six kilometres (33% of car2go trips) followed by trips of eight kilometres or more (23% of car2go trips). The distance profile of the car2go trips is closer to, but longer than, other motorised trips within the Home Area and significantly longer than cycling or walking distances.

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

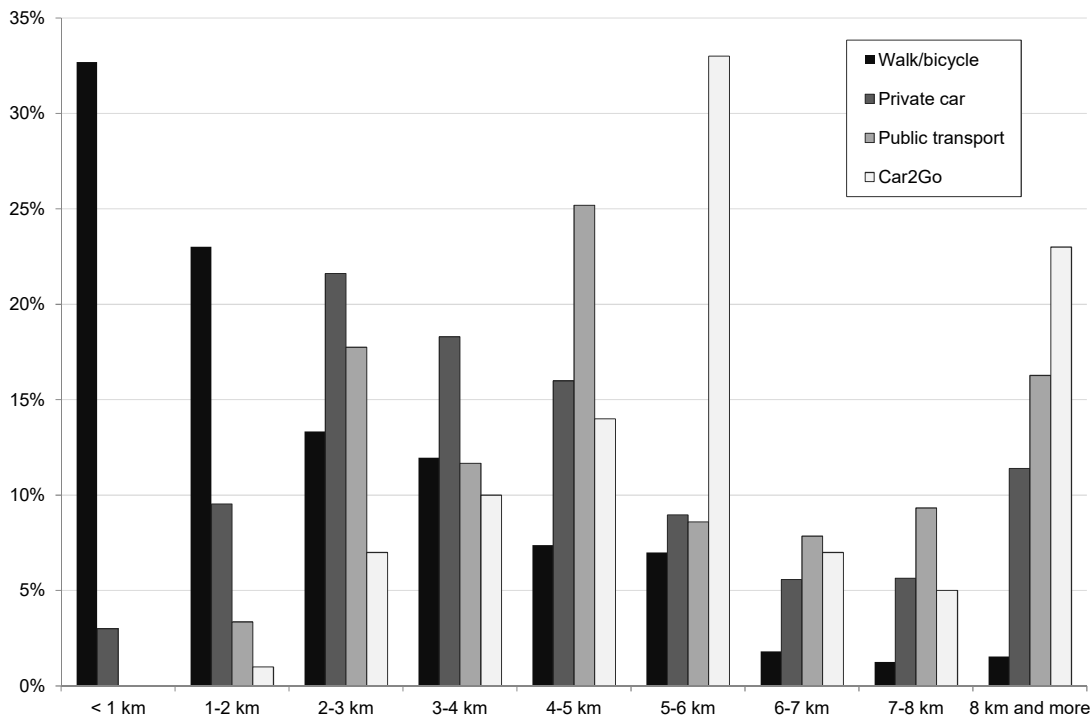


Figure 1: Trips by mode within the Home Area (Source: the Danish National Travel Survey 2014 (TU) and the present car2go survey data).

Most car2go users (43%) stated that their last trip was a leisure trip. The second most common trip purpose was business trips with 14%. Shopping and commuting each represented 11%, while 9% stated that their last trip was simply to test car2go cars and the concept, which reflects that the system was still new in Copenhagen at the time of the survey. 6% stated other reasons, such as going to the airport or having temporary physical constraints, whereas 5% stated that they had to transport goods. While the categories used in the questionnaire related to DriveNow were not completely comparable, leisure trips were also the most important trip purpose (37%), followed by commuting to work or education (17%), and shopping and running errands (15%).

As a sequel to the trip purpose, respondents were asked about the car's occupancy rate and their reason for using car2go for the trip in question. In 53% of trips, car2go were used in the company of a second person, which is rather high and possibly linked to the high level of leisure trips.

Car2go was mainly used because it was regarded as an easy and fast transport option as indicated in Table 3. The weather was mentioned as a reason for using car2go by 30% of respondents. The influence of weather on the choice of transport mode (see Figure 3) was correlated significantly with the frequency of car2go use ($\rho = .34$; $p = .001$): the more sensitive people were to bad weather conditions regarding transport choice, the more often they used car2go. 10% of respondents stated that they used car2go because it was cheap, possibly influenced by some car2go users being offered free driving minutes when signing up. Although most respondents felt it was necessary to consume less in order to create a more sustainable world (see Figure 3), only 41% considered this in their transport choice by stating that it was important to them that their transport mode was environmentally friendly. Likewise, for the majority, electric cars would not make the use of car2go more appealing.

Table 3: Reason for using car2go

	<i>n</i>	Percent of answers	Percent of respondents
The easiest	55	38%	66%
The fastest	51	35%	61%
The weather	25	17%	30%
The cheapest	9	6%	10%
My transport option was out of order	6	4%	7%
Total	146	100%	174%

Note. 49 respondents indicated only one alternative mode whereas 46 indicated two or more. The total number of answers ($n=146$) therefore exceeds the number of respondents.

Respondents were asked how they would have made the trip if not using car2go (see Table 4). This question allowed for multiple responses, and 57% respondents would have chosen public transport while 29% would have cycled. Taxis were mentioned by 25% of respondents, and 4% said they would have used a private car or walked. 7% stated that they would not have made the trip at all. Some of these were system try-outs. For DriveNow users, 47% would have chosen public transport, 21% would have cycled, and 18% would have taken a taxi, so the order of the main replaced modes is the same.

None of the respondents, who listed their last trip with car2go as a trip that otherwise would not have been taken, owned a car and they rarely, or never, drove one. Instead, they were daily or weekly cyclists.

Table 4: Alternative transport modes to car2go

Alternative mode to car2go	<i>N</i>	Percent of answers	Percent of respondents
Public transport	54	45%	57%
Bicycle	27	23%	29%
Taxi	23	19%	25%
Car	4	3%	4%
Walking	4	3%	4%
I would not have made the trip/ no alternative	8	7%	9%
Total	120	100%	128%

Note. 73 respondents indicated only one alternative mode whereas 22 indicated two or more. The total number of answers ($n=120$) therefore exceeds the number of respondents.

4.1.3 Transport patterns and car ownership

Transport patterns

The frequency in use of transport modes is shown in Figure 2. It is apparent that most respondents were daily cyclists, as 58% noted this was their daily mode of transport, while 24% of respondents were daily public transport users, and 16% were daily private car users. Not surprisingly, car owners cycled less frequently ($U = 465.0$, $p < .01$), used public transport less frequently ($U = 341.0$, $p < .001$), and the car more often, ($U = 31$, $p < .001$), while there was no significant difference in taxi use depending on car ownership ($U = 710.5$, $p > .10$). Moreover, car-owners used Car2go less often ($U = 587.5$, $p < .05$): While 16% of non-owners used Car2go weekly, it was only 5% of car-owners.

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

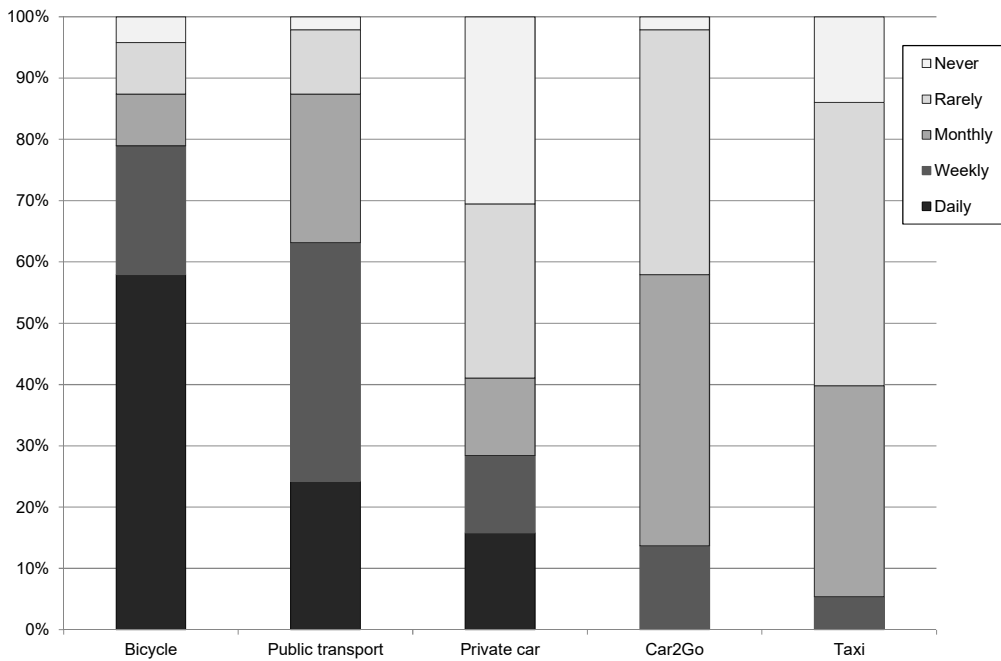


Figure 2: Frequency in use of transport modes

Driving and cycling frequencies are also reflected in the observed travel behaviour of the respondents' social network, because 76% agreed, or strongly agreed, that the bicycle was the primary mode of transport in their social network, whereas only 18% primarily used private cars (see Figure 3).

In line with the low car usage, the majority of respondents (73%) disagreed, or strongly disagreed, that a busy life made it necessary to drive a car in Copenhagen (see Figure 3). The frequency of taxi use was the only mode of transport that significantly and positively correlated with the frequency of car2go use ($\rho = .303$; $p < .001$): the more often members used a taxi, the more often they used car2go.

Two of the seven statements in Figure 3 were significantly related to car ownership: Car owners agreed more than non-owners that the car was the primary mode of transport in their social circle ($M = 2.2$ vs. 1.4 , $F = 21.34$; $p < .001$) and that everyday life makes it a necessity to use a car ($M = 2.0$ vs. 1.2 , $F = 21.34$; $p < .001$). Yet, both car owners and non-owners on average disagreed with these statements.

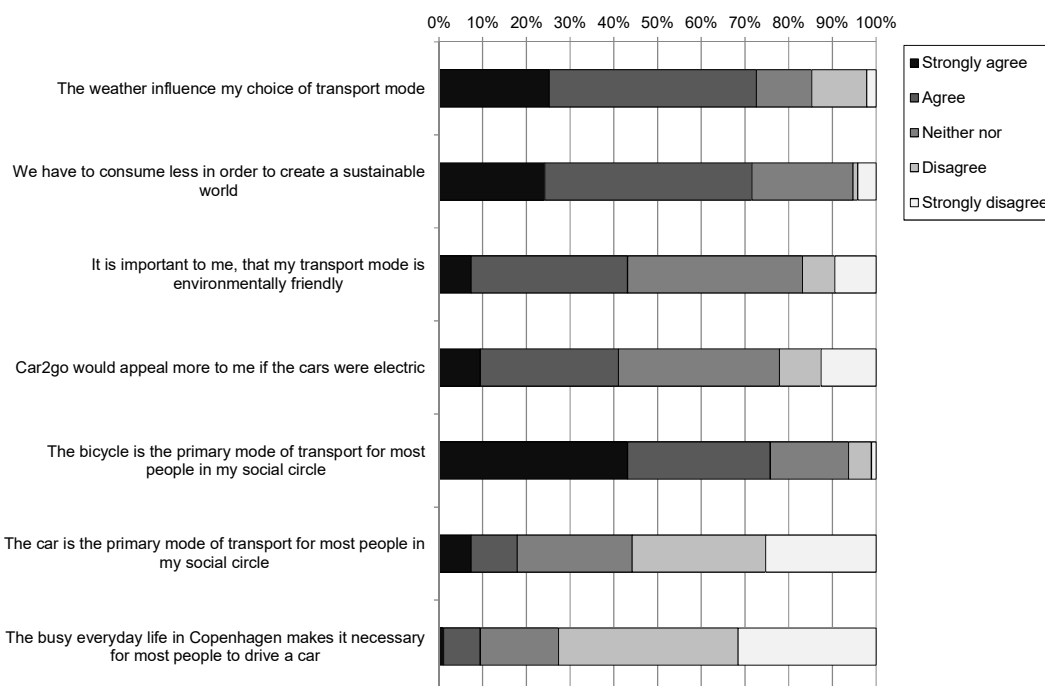


Figure 3: Environmental concern, attitudes and norms in relation to travel mode choice

Actual and intended car ownership

Of the respondents, 23% were car owners, while the 77% majority did not own a car (although 22% stated that they had access to a car through family or friends). Of the 23% car owners (n=22), four respondents had considered selling their cars. This consideration was to a large extent affected by car2go for two respondents, whereas a third was affected to some extent, and the fourth was not at all affected by car2go. In the case of DriveNow, half of respondents had access to a car in the household. It is likely that the younger car2go users – to a larger degree than DriveNow users – represent early adopters.

More than half of the non-car owning car2go users (n=39) had considered buying a car at some point in time. However, of these 40% still considered buying a car while 14% did not. The members that no longer considered buying a car were asked to what extent car2go had influenced that decision. Of the ten respondents who were asked this question, four noted that car2go did not influence their decision at all, while four answered that car2go had influenced them to some extent, and the final two respondents answered that they had been influenced to a large extent by car2go. Both of the latter were male students below the age of 30 and used the bicycle and public transport weekly.

In case of DriveNow users, 71% had neither the intention to buy or sell a car, nor to replace an existing car. While 15% were considering or planning to buy a car, 3% were considering to reduce car ownership. The remaining 11% were considering replacing a car in near future.

Some of the users also participated in other forms of carsharing services. Of all car2go users, 12% stated that they were member of other carsharing services (peer-to-peer as well as station-based carsharing). In case of DriveNow, 8% were additionally members of a station-based carsharing service, 20% had used peer-to-peer carsharing within the past 12 months, while 45% had borrowed a car from parents or friends within the same period.

4.2 Results of the in-depth interviews

Considering the results of the survey and the in-depth interviews, it became relevant to differentiate between car owners and non-car owners, as car ownership status was found to influence what car2go was used for, how it was used, and why. The results of the qualitative interviews illustrated these differences in greater detail and are presented separately for car-owners and non-owners.

4.2.1 Non-car owners

When asked of their motives for using car2go, the non-car owning interviewees emphasised their practical need for transporting goods or going out and saving taxi fares. They also stated that car2go had not increased their total number of trips but that car2go offered a more convenient alternative. As one interviewee explained, his needs had not changed since joining car2go, but the way he addressed them had:

Before I would have taken a taxi or used public transport, but it didn't offer the same flexibility. My needs to go grocery shopping or buy a lot of heavy things and bigger things that you cannot carry on your bicycle have always been there. Before I just struggled with it on the bus or took a taxi, which was more expensive.

Per (33)

Also, bad weather conditions were stated as a reason to use car2go and thereby increase travel comfort:

During the wintertime, I used it a lot, simply because I couldn't be bothered to stand and wait for the bus. When the bus finally comes, it's completely packed with people, it's wet and cold and it smells. With car2go I just blast the heat. I'll gladly spend more money on being comfortable.

Yasmin (26)

However, the relevance of the weather widely varied among users and in particular for dedicated cyclists the weather or season was not a relevant factor:

Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

I bike everywhere, I cannot remember the last time I took the train or a bus [...] I have a lot of friends, who take the train or the bus during winter, but I don't. I bike to and from school and work and to other places all year around.

Louise (23)

Still, the possibility to avoid the discomfort of riding by bus was a motive that was found both among cyclists and non-cyclists:

The bus? No thank you! Only if I really have to! But I hardly ever use it, as buses often represent a distance I prefer to cover by bike [...] I hate taking the bus. The S-trains I can live with, the Metro is okay, but buses are just... [...] you have to sit closely to people with poor hygiene or teenagers who don't understand the concept of headphones and that not all of us want to listen to their music.

Per (33)

The most frequently stated limitation among the non-car owning members was the fact that the system was only suitable for shorter trips within the car2go Home Area. The interviewees, who mentioned this as a barrier, argued that when they really needed a car, it was for longer distances far away from Copenhagen when public transport was inconvenient and expensive. Thus, car2go was considered to be too expensive for full day rentals compared to other carsharing services (especially peer-to-peer). For longer trips, therefore other solutions were used, such as borrowing a car from parents or friends:

My parents' car is primarily for longer trips, if I need to go and play football or golf or whatever you do, drive out and visit someone further out from the city. So it [car2go] does not cover the same needs. It covers my needs within the city, but not outside of the Home Area [...] It will probably never completely cover my [car] needs.

Frederik (26)

The trips that the non-car owners would take with car2go always had a specific purpose. One interviewee used it especially for business trips:

I don't use it a lot in my everyday life. Not privately at least. I use it for work if I have to transport heavy equipment and such – I just can't do that on my bicycle, so it's really a question of practicalities.

Benjamin (24)

All non-car owning interviewees were daily cyclists or public transport users and perfectly capable of getting around without a car; thus, trips by car2go were often described as extraordinary trips:

I either bike or take the train to work so I don't use car2go for commuting. It's mostly at night if I have to go to the city centre or if I'm out having dinner or something – those little trips where it makes sense, because it's not like it's much more expensive than riding the bus for example.

Frederik (26)

While most non-car owners used car2go occasionally, a few members were much more frequent users. This pattern was also confirmed by car2go in an exchange about findings after the survey and interviews had been conducted. One of the interviewees expressed a more frequent usage of car2go and used it for all types of trips; even commuting, which the others considered too expensive:

I probably use it more often than I should. Because I have a monthly bus pass – I have it and it's valid, but you become addicted to it [car2go]. It's stupid, actually.

Yasmin (26)

For some non-car owning users, car2go replaced bicycle trips, while for others it replaced public transport. But according to the interviewees, the discussion of what car2go replaced was much more complex than just

substituting one mode for another. Several aspects influenced their choices such as trip purpose, as well as their individual travel behaviour and routines. Another significant commonality amongst the non-car owners is that they all (as young adults living in the city without children) valued not having a private car in this particular time of their lives, when they only needed a car occasionally, and therefore, wished to avoid the costs of owning one.

4.2.2 Car owners

What characterised car owners most significantly with regard to their car2go usage is that it differed from the use of their private car and, according to the interviewees, the two uses are not comparable. Rather than being a substitute for their private car, car2go was considered a supplement similar to taxis, public transport, and to a lesser extent cycling. The interviewed car owners all agreed that bringing their private car to the city was inconvenient, as it limited the flexibility of the driver and was expensive in parking fees, and they all generally wished to avoid it. Therefore, the car owners used car2go especially for running errands in the city or when socialising with friends. Moreover, they knew beforehand that they would not be capable of driving home. In addition, they were hesitant about having to leave their cars in the city overnight in case they were damaged, but also simply because it was inconvenient to have to pick it up the following day. Among the car-owning users were both practical car users as well as enthusiastic car addicts who highly appreciated the symbolic value of the car for themselves and their peers:

A lot of them [my friends] have the same issue as me; that you can't afford the cars you really like. Someone will say 'I want that BMW when I turn 40' or something [...] Boys either like cars or they don't and in my group of friends we all do [...] it's just cool to have a nice car. It also sends a signal that you are doing well financially.

Stein (27)

None of the car-owners believed that car2go had the potential to replace their private car(s). Barriers to the use of alternative modes were described both with regard to public transport and cycling:

I'm actually surprised that so many people ride their bicycles here because the weather so often is bad [...] but in general, though, I find it difficult to hop on my bike. The first issue that comes to my mind is that if I have just showered and done my hair, it'll be all messy after riding my bicycle. I think that is very annoying.

Stein (27)

An interviewee living outside the Home Area, explained that his house was located far from a train station or a bus stop and therefore he would usually drive his car to work. Since rarely using public transport, just having to buy a ticket for the bus or finding the right bus stop was a barrier. He was simply unaccustomed to public transport:

For me it is much more difficult to book a bus ticket with my phone than to use the car2go app, find a nearby car, and swipe my card. Then money is just drawn from my account without me doing anything, but mentally, I don't feel like it's costing me money.

Danny (39)

Even though the system that our respondent, Danny, was describing, sounds very similar to the Danish electronic ticketing system for public transport (smartcard/Rejsekortet), he did not associate this with the same level of accessibility as the car2go system. For him using public transport was a deviation from his normal travel routines, which made it additionally difficult to use. A car, on the other hand, was something familiar to him and therefore, car2go's system seemed more approachable and accessible.

4.2.3 Similarities in usage

Both car owners and non-car owners explained that car2go covered a missing link between having to take a bus or a taxi by making the trip more flexible, especially for one-way transportation. Several cited the

example of going out at night and not wanting to bring their bicycle or car and they preferred to use car2go rather than taking a bus or taxi, which could get them directly to their destination more cost-efficiently than a taxi and more conveniently than a bus. The interviewees often referred to the trips taken by car2go as extraordinary trips or a luxury, although their definition of what made a trip extraordinary varied. Moreover, the interviewees stated that they were taking more trips by car and driving more kilometres than they did before joining car2go.

Another interesting commonality was that they all had a need for a car not covered by car2go. Whereas car owners would use their private car for everyday trips or long-distance commutes, non-car owners either had access to a car or were members of another carsharing service. In particular peer-to-peer carsharing and car2go was a preferred combination to cover the car need of some non-car owning members. Only one interviewee was a member of a station-based carsharing organisation, while several of the others stated that they were not interested in this type of carsharing, because it was considered less accessible and more expensive than peer-to-peer services. Moreover, the monthly fees and payment model of station-based carsharing were stated as being unattractive making rental costs difficult to foresee.

5. Discussion

As in studies from other cities such as Basel, Berlin, Munich, and London (e.g., Becker et al., 2017; Kopp et al., 2015; Firnkorn & Müller, 2012; Le Vine, Lee-Gosselin, Sivakumar, & Polak 2014), free-floating carsharing users in our survey were predominantly young males working full time with a high level of education. While specific socio-demographic profiles are thus clearly related to free-floating carsharing membership, socio-demographic variables were not related to the frequency of car2go use among members. In terms of travel patterns, it was found that car2go members in Copenhagen used public transport and bicycles on a daily or weekly basis. In contrast to other transport modes, taxi use correlated positively with frequency of car2go use. In addition, it was respondents whose travel mode choices were influenced more by weather, who used car2go more frequently. This is in line with earlier findings demonstrating that sensitivity to bad weather increases car use and decreases cycling (Haustein, Hunecke, & Manz, 2007; Haustein, 2012; Hunecke, Haustein, Grischkat, & Böhrer, 2007). Likewise, it has been shown that weather changes have a short-term effect on free-floating carsharing usage, namely that it is used more frequently when it rains (Schmöller, Weikl, Müller, & Bogenberger, 2015). This may indicate additionally that free-floating carsharing especially attracts people, who are more sensitive to bad weather conditions. As Copenhagen has a high cycling share even in winter (Haustein, Koglin, Nielsen, & Svensson, 2020), conditions for free-floating carsharing may be worse compared with cities having a less pronounced cycling culture. Car2go in Copenhagen was primarily used for travel distances within the Home Area where bicycles generally are the dominant transport mode.

With respect to travel purposes, the most common purposes for car2go (and DriveNow) use were leisure or business. This differs from results obtained from a London free-floating study, which found that commuting accounted for 50% of trips (Le Vine et al., 2014).

A main difference, especially from German studies (Firnkorn & Müller, 2012; Kopp et al., 2015), was that car2go users in Copenhagen had a significantly lower level of car ownership, though, the deviation from Swiss studies (e.g., Becker et al., 2017) was much lower. Most car2go users in Copenhagen were daily cyclists and did not own a car. They preferred car2go when cycling was an inadequate choice or temporarily not possible, when using public transport was perceived inconvenient or uncomfortable, and when taking a taxi was considered to be too expensive. Cycling was part of most users' routines and this was also reflected in their descriptive social norms. Driving a car within Copenhagen was mostly not viewed as a necessity, possibly owing to the good cycling conditions and to an overall well-functioning public transport system. The only part of the public transport system several cyclists as well as public transport users felt uncomfortable with, was the bus and thus car2go was in some cases even chosen when a good bus connection was available. In these cases, car2go appeared as an alternative transport mode for people who highly value the privacy and autonomy of individual transport modes and disliked too close contact to other passengers. Similar as in previous research, it seemed that worse-case scenarios were used to make generalizations about bus travel (Guiver, 2007). If bus traffic wants to compete with the growing number of alternative services, improvements seem to be required, which not only focus on functional aspects like speed and price but also on affective aspects, e.g., by increasing the space between seats, offering a sufficient number of buses during rush-hours, improving the air condition

and providing adequate shelter when waiting for a bus in bad weather conditions to make the bus trip an overall more pleasant experience.

The car owners amongst car2go users had different motives for using car2go. For them, car2go was mostly a substitute for their private car and in contrast to non-car owners, they partly placed high symbolic value to the car. In certain situations, bringing the private car into the Home Area was regarded as inconvenient, especially when the purpose was to socialise at night. In those cases, car2go replaced a seemingly complicated trip with public transport and offered additional flexibility. Then car2go was more imbedded into existing car user routines as compared to relying on a public transport system car-owners rarely used and were unfamiliar with. Thus, for car-owners the service did not seem to support multimodal transport use but rather to be a way to avoid it.

For both car owners and non-car owners, car2go had some limitations and it was rather used to complement existing modes than to replace them, which is in line with previous research (Namazu & Dowlatabadi, 2018). Car2go had not been integrated into the users' daily routines, as it could not compete with primary transport modes due to affordability and convenience. This is a barrier and could be part of the explanation for why car2go withdrew from Copenhagen. Another critical factor was the lack of parking subsidies in licenses provided by the local city government. Car2go has also withdrawn from other cities including London and Birmingham in the UK where the local city governments also did not provide sufficient subsidies for the free-floating system (BBC 2014). Parking, including the allocation of parking rights to carsharing cars, has been described as key elements of urban policies supporting carsharing in Sydney (Dowling & Kent, 2015; 2016). This suggests that parking rights or subsidies may indeed be critical for the viability of these systems from a business point of view. This is reinforced by the example of London where the Home Area is five times the area of Copenhagen and the difference in user patterns with a large share of commuting suggested a much stronger base in everyday travel needs in London. After car2go, DriveNow, followed by GreenMobility were launched as free-floating carsharing services in Copenhagen. In the beginning only with electric cars, which was the reasons why parking subsidies were provided (an environmental discount). The current systems seem to be running more successfully and may, in addition to reduced parking fees, be able to benefit from their alignment with ambitions to promote green mobility and electric vehicles as well as a longer term engagement in the region, which has also allowed adaption of services and extensions of the Home Area to include activity centres outside the City of Copenhagen. Compared to other large cities around the world the market for carsharing in Copenhagen may also benefit from peer-to-peer taxi services such as Uber being considered illegal and thus unavailable.

To the authors' knowledge, this is the first study on free-floating carsharers' user experience combining quantitative data and in-depth insight into users' specific motives and perceived limitations of the system. While this can be regarded as strength of the study, the small size of the sample is a limitation, which we tried to compensate with providing additional data from a larger survey of DriveNow users that partly included the same or similar questions. Survey data may additionally be biased by factors such as social desirability and the recruitment via Facebook might have contributed to self-selection and non-response bias. The reported influence of car2go on past or future decisions to dispose or buy a car may additionally be subject to memory bias and/or hindsight bias (Roese & Vohs, 2012). In addition, attitudinal factors addressed in the survey, were only operationalised with single items instead of multi-items scales, which would be preferable to obtain reliable results.

Longitudinal studies, including data from before and after membership (Becker et al., 2018; Haustein & Jensen, 2020) show smaller effects of free-floating carsharing on reducing car ownership than commonly reported for stations-based carsharing. In line with this, the results of the in-depth interviews indicated that car owners would not get rid of their private car because of car2go because the service covers an additional need, not covered by the private car. For non-car owners, car2go was surely one element that facilitated continuing car-free living, but it was also insufficient to cover all members' occasional car needs. Few users got accustomed to the convenience of car use and used car2go more than what was economically reasonable. This may increase a future need for owning a car because station-based carsharing was not considered as an alternative because of minimal flexibility. In line with previous studies (e.g., Jain et al., 2020), the results showed that the decision to become a car owner, or to stop being one, often involved several considerations and resulted from a mixture of different concerns. Some respondents also participated in other forms of carsharing services and thereby covered their car needs, and this is where the potential effect of free-floating carsharing on car

ownership is found: The combination of free-floating carsharing for short trips and peer-to-peer or station-based carsharing for longer trips can cover the need for more convenient leisure and business trips within the city and for longer trips were alternatives can be quite limited.

6. Conclusion

The paper has analysed the practices and motives related to the use of a free-floating carsharing service in Copenhagen, a city with a distinct cycling culture. Data were collected by means of a questionnaire and in-depth interviews within the first year of the launch of car2go, supplemented with survey data collected within the first year of the launch of DriveNow. Users of free-floating carsharing were found to be mainly young, highly educated, male, and living in the city centre. This corresponds to findings from other studies. However, different from other studies, most of the users were also daily cyclists and did not own a car.

A key finding was that car2go did not substitute or compete with primary transport modes, especially since car2go (as well as DriveNow) was only used to a small degree for commuting. Based on in-depth interviews, different motives and user patterns could be identified depending on car ownership status. Non-car owners primarily used car2go for leisure or business trips and for transporting goods when cycling was an inadequate choice or temporarily not possible, when using public transport was perceived inconvenient or uncomfortable, and when taking a taxi was considered to be too expensive. Car owners mostly used car2go to avoid driving their private car in the city. For both car owners and non-car owners, car2go had some limitations. It could not replace the private car especially concerning long distance trips, where there may be no alternative. For the non-car owners there was almost always an alternative to car2go's shorter distance trips within the boundaries of the Home area. Moreover, car2go was not integrated into the users' daily routines, as it could not compete with primary transport modes due to affordability and convenience.

The findings from this study suggest that living in a cycling city, where cycling is part of people's common practice and norms, influences the way carsharing is used and probably makes it more difficult for carsharing being a success. Many other factors from market size and density to access conditions and costs are of course also important and it is not possible on the basis of this study to identify the set of factors that effectively caused car2go to withdraw from Copenhagen.

In contrast to the existing quantitative studies, our qualitative results illustrate that the profiles of free-floating carsharers are more different than one might expect based on socio-demographic profiles of the prototypical highly-educated young male users. When looking at them individually, users reach from dedicated cyclists, who only use a car in emergency cases, to users that prefer car over all other modes and for whom the car has not lost any of its symbolic value.

Generally, car2go users highly valued the flexible one-way service offered by free-floating carsharing but use-patterns were characterised by rare and infrequent occasions or curious trials. Furthermore, although the users all expressed an occasional need for a car, car2go could not solely accommodate this need. The withdrawal of car2go from Copenhagen reflects the difficulties of achieving a large consumer base in a city with a high share of people cycling.

The user experiences suggest that the potential for free-floating carsharing to decrease car ownership may depend upon combinations with other carsharing services to allow car travel over longer distances and durations. However, in its current form, station-based carsharing was not found appealing by the free-floating users. A higher degree of flexibility or integration of the carsharing services may be required. A key question for carsharing in addition to the effect upon users' car ownership and driving will be its appeal to users and uptake in larger segments of the population. Future studies should target this issue, including the role of urban policies e.g. with respect to parking.

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Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

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Free-floating carsharing in Copenhagen: A study on user experience in a cycling city

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