The impact of free-floating carsharing on car ownership: Early-stage findings from London

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Abstract

Free-floating carsharing is a rapidly growing urban mobility service. It has emerged at commercial scale more recently than traditional 'round-trip' carsharing, and at present its growth trajectory is steeper. The evidence base regarding its impacts on sustainable transport indicators is, however, less well-developed. This issue is topical for a variety of reasons, including the importance of public policy to the success of this form of carsharing.

The research objective of this study is to establish the early-stage impact of free-floating carsharing on private car ownership. We report findings from a point in time three months following the initiation of a free-floating carsharing service in London (UK). We investigate characteristics of FFCS users that are associated with having one's car ownership impacted, as well as the distinction between deterrence of increased car ownership and sale/disposal of a previously owned private car.

We find that 37% (n=347; 95% confidence interval: ±5%) of users indicate that free-floating carsharing has impacted their ownership of private cars. Of this 37%, a large majority (83%) indicated that the mechanism of impact was that they decided not to buy a car that they otherwise would have purchased. 11% reported that they had disposed of a car in the past three months, and 6% stated that they will sell a private car within the next three months.

The average income and education level of users are both higher than for the general population. Within the population of service-users, multivariate analysis demonstrates that, net of confounding effects, heavier (more-frequent) service-users are more likely to indicate impacts on car ownership, and that being highly-educated and higher-income than other users were both (independently) associated with maintaining one's car ownership level. Additional findings are presented that relate car ownership impacts to further demographic characteristics as well as behavioural indicators.

Our findings should be interpreted to pertain to the 'early adopter' cohort of FFCS users, and as free-floating carsharing services mature and grow further research will be needed to ascertain how user characteristics, behaviour and impacts are evolving.

Keywords: Free-floating carsharing, Point-to-point carsharing, Car ownership impacts, Logistic regression

1. Introduction

Smartphone-enabled mobility services are becoming increasingly prevalent in urban areas. Free-floating carsharing (FFCS) is a mobility service in which the user locates a nearby available vehicle (typically via an app on a smartphone), drives him/herself to their destination (typically paying on a per-minute basis), and subsequently ends the usage after the one-way usage. This differs from traditional 'round-trip' carsharing[1] in two important respects. First, FFCS use is in general spontaneous, whereas round-trip carsharing operates on the basis of advance reservations. Second, round-trip carsharing is generally charged on an hourly basis, encompassing the period of time from when the beginning of a reservation (when a vehicle is taken) until the end of the reserved period (at which time the vehicle must be returned to the same location). "Station-based, one-way" carsharing is a close variant of FFCS, the difference being that vehicles are picked up and dropped off at specific 'station' locations, rather than at any legal parking space (hence the term 'free-floating'). Carsharing in general is distinct from another rapidly-growing mobility service – Transportation Network Companies (TNCs, cf. CPUC 2015) – in that the customer is chauffeured by a professional driver during journeys in TNC vehicles.

Free-floating carsharing services are found in several dozen cities of high-income countries (Shaheen et al. 2015), and are now beginning to appear in middle-income societies (Korosec 2016). In order to balance between providing access to a large number of potential customers and providing a high density of vehicles (which supports high levels of liquidity from the customer's perspective) , FFCS service areas tend to cover the urban core and inner suburbs of a metropolitan region, but not outlying areas with lower densities of population and economic activities.

The objective of this research is to characterize the early-stage impacts of FFCS on its users' ownership of private (household) cars, using data from the DriveNow FFCS service in London (UK). In many cities, FFCS requires affirmative policy actions from the public-sector entity(ies) that manages on-street parking space in order to provide services. Therefore, establishing FFCS' impacts is important to enable efficient coordination between private-sector FFCS operators and public-sector bodies with responsibility for overseeing parking. To the authors' knowledge, this study's original contributions include findings regarding which characteristics of FFCS users are associated with having one's car ownership impacted, and (separately) the characteristics associated with having an increase in one's car ownership deterred by FFCS participation (versus actively disposing of a private car).

The remainder of this paper is organised as follows. Section 2 presents background on free-floating carsharing. Section 3 describes the data and methods employed on this study. Statistical results are presented in Section 4. Section 5 discusses the findings and concludes the paper with a discussion of future research needs.

[1] Other variations of carsharing exist; readers interested in, for instance, *peer-to-peer* carsharing (in which ownership of the fleet is decentralized) are referred to Bewick et al. (2013), Ballús-Armet et al. (2014) and Dill et al. (2014).

2. Background

Carsharing services have been the focus of much attention from transport researchers (cf. Loose [2010], Shaheen & Cohen [2012] and Jorge and Correia [2013] for broad reviews of the various strains of literature relating to carsharing, and Robert [n.d.] for an open-access repository of major studies of carsharing beginning in the 1960s). While understanding the dynamics of carsharing is of interest in its own right as a growing form of mobility service (which itself is widely conceived as part of the wider 'sharing economy, cf. Fraiberger and Sundarajan 2016), there are additional reasons for interest from both researchers and policymakers. First, although customers generally use carsharing services for a small proportion of their overall journey (Bewick et al. 2016), there is strong evidence of impacts to the remaining larger proportion of customers' mobility. This appears to be particularly pronounced among customers who report having reduced their private-car ownership in conjunction with joining a carsharing service (Le Vine 2011), which is the focus of the present paper. Second, many types of carsharing services, typically including FFCS, require explicit agreement with the public sector in order to operate (Taylor 2014[2], Shaheen et al. 2010), and policymakers therefore have a direct interest in understanding the nature and magnitude of the wider impacts of carsharing services.

Researchers have therefore been motivated to investigate the impacts of carsharing on private-car ownership, and a body of literature has been developed; the typical finding is that a substantial minority of carsharing customers report having reduced their private-car holdings (Cervero et al. 2007, Martin and Shaheen 2010, Firnkorn 2011, Bewick et al. 2016, Martin and Shaheen 2016). This impact is frequently characterized as the ratio between the number of privately-owned cars that customers sell (or otherwise dispose of) and the number of vehicles in a given service's fleet of shared cars.

Researchers have employed a range of methodological approaches to analyse mobility services, depending on the specific research question under investigation. The most widely-used approach is to survey carsharing users (e.g. Baptista et al. 2014; Martin and Shaheen 2010, 2016; Katzev 1999, Bewick et al. 2013, 2015; Cervero 2003; Cervero and Tsai 2004; Cervero et al. 2007, Becker et al. 2015; Firnkorn 2011; Robert 2000). A second general approach is to statistically analyse operational data (i.e. databases on users and transactions generated by the carsharing operator's systems); examples include Martin (2007) and Schmoller et al. (2015). Klincevicius et al. (2014) presented a novel analysis of car ownership impacts using data from Canada's census. Simulation studies have also been performed to both forecast the take-up of carsharing services (e.g. Ciari et al. 2014; Le Vine et al. 2014) and also to evaluate the logistics of carsharing fleets (e.g. Correia and Antunes 2012, Nourinejad and Roorda 2015, Hu and Liu 2016). Finally, it is worth noting that there are a growing number of examples of regional/national-scale travel surveys collecting data on respondents' access to and usage of carsharing services (e.g. Switzerland OFS 2010; Kunzmann and Masterman 2013; Lepanjuuri et al. 2016; PSRC 2015)

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[2] Taylor (2014) reported that an FFCS *"had hoped to establish a network of 'free floating' parking spaces across London where customers could pick up and drop off cars. But coordinating 32 separate authorities across different boroughs proved to be more difficult than anticipated"*

As described in the next section, this study addresses the initial impacts of a FFCS service shortly after its introduction. There is a well-established body of literature which documents that early adopters of innovative products/services have distinctive characteristics from later-adopting groups, traditionally termed the 'early majority', 'late majority' and 'laggards', cf. Rogers 1962, Robinson 1967, Mahajan et al. 1990, Meade and Islam 2006). Two bodies of work exist which have monitored the maturation of round-trip carsharing in the United States (Cervero 2003, Cervero and Tsai 2004, Cervero et al. 2007) and the United Kingdom (Bewick et al. 2016, preceded by earlier studies undertaken annually beginning with Carplus 2008). It will be necessary to compile a similar database of evidence regarding FFCS, of which this study is an initial contribution. Table 1 summarises previous studies of round-trip and one-way carsharing along several dimensions of interest, including both simulation studies (Ciari et al. [2014]; Le Vine et al. [2014]) and empirical studies (6t Bureau de Recherche [2014]; Bewick et al. [2016]). A consistent result is one-way carsharing (whether FFCS or station-based) having a higher frequency of usage per customer than round-trip carsharing (Becker et al. [2015] also report results consistent with this pattern). Additionally, Schmoller et al. (2015) demonstrate that FFCS systems in Germany are busiest on weekends, with usage increasing during the course of the working week, and that 25-30% of observed FFCS journeys covered less than 1.6 km in 'crow-flies' distance.

3. Data and Methods

The empirical data were collected via a web-based self-administered survey undertaken in March 2015. The sample was recruited (via e-mail solicitation) from customers of DriveNow, a FFCS operator which began operating a fleet of approximately 250 vehicles across three of London's 33 boroughs in December 2014 (three months prior to the survey fieldwork).[3]

A total of 1,834 FFCS users were invited to take part in the survey; n=347 responses were received (response rate of 18.9%), of which n=298 (an adjusted response rate of 16.4%) respondents completed all questions used in this study (and hence were included in the regression analysis). This compares favourably to response rates reported in earlier studies of carsharing with evidence sourced from surveys of carsharing customers, e.g. 3% (Bewick et al. 2016), *"between 5.4% and 11.1%"* (p.61, Sioui et al. 2013), 10% (Martin and Shaheen 2010), and 19% (Cervero et al. 2007).

The questionnaire's item concerning car ownership impacts was worded as follows:

> *Which of the following statements most closely applies to you: Because of DriveNow…*
>
> 1. *The number of cars I own didn't change during the last three months.*
> 2. *I decided not to buy a car during the last three months.*
> 3. *I got rid of a car during the last three months*

[3] The entry of DriveNow into London followed a pilot FFCS service (approximately 30 vehicles in one London borough) of another operator (car2go), which began service in December 2012 and terminated in May 2014 (Le Vine et al. 2014). In addition, London is home in 2015 to approximately 186,000 members and 2,500 vehicles of round-trip carsharing services (Bewick et al. 2016)

4. *I will get rid of my own car in the next few months*

Both demographic characteristics (gender, age, income level, education level, household structure, private car ownership) and behavioural descriptors (types of activities accessed via the FFCS service, frequency-of-use of various modes of transport) were also collected as part of the survey questionnaire. A limitation of the data-collection protocol is that no information is known regarding the home addresses of individual survey respondents', which precludes us from considering in this study characteristics of the local built environment in which FFCS customers reside.

The data analysis strategy comprised two elements: analysis of descriptive statistics and binary logistic regression. The regression analysis consisted of two models. Model #1 identifies factors associated with a respondent indicating that the availability of FFCS has had *any* impact on their ownership of private cars (i.e. any of items #2-4 from the numbered list earlier in this section). Model #2, by contrast, analyses the distinction between *'deterrence of car ownership'* (item #2 in the listing above) and *'disposal of private cars'* (items #3 and #4 in the listing above), conditional on a respondent having indicated that the FFCS service's availability had an impact of some kind (items #2-4) on their car ownership level. This model analyses these distinctive behavioural regimes associated with FFCS usage, with deterred car ownership implying continuation of an existing low-/non-car-owning status, whereas disposing (and planning to dispose) of a private car characterises an action that actively reduces or eliminates one's access to a private car, relative to a current status.

4. Results

In this section we first present results first from a set of descriptive statistical analyses, followed by logistic regression analyses.

4.1. Demographic profile

We begin with the demographic profile of FFCS customers. From Table 2, it can be seen that survey respondents are distinctive (in comparison with the population at large in the FFCS service area) as they tend to be male, to have an average age in the mid-30s, to be relatively well-educated, have higher-than-average household income, and to be more likely than average to have children in their household. It is of note that this profile of early-stage FFCS customers is consistent with the demographic profiles of FFCS customers in other cities (Kopp et al. 2013, Kopp et al. 2015), of round-trip carsharing customers in London (Bewick et al. 2016), and of bikesharing customers in London (Woodcock et al. 2014). The overall level of household car ownership amongst FFCS customers is, however, comparable to the car ownership rate for the general population (0.56 versus 0.55 cars/household). With respect to income, the finding that the average income level of FFCS users is higher than the population at large in the service area holds both among FFCS users that indicate that their car ownership has been impacted and among those that report no such impact.

4.2. Distribution of car ownership impacts

Table 2 also demonstrates the headline distribution of car ownership impacts. It can be seen that 63% of FFCS users indicate that the introduction of the service did not affect their ownership of private cars. Of the 37% that reported impacts, the most frequently stated is a 'deterrence' type: 30% of FFCS users (83% of those reporting any impacts) indicated that

during the three months prior to the survey, they did not purchase a car that they otherwise would have purchased. Much smaller proportions reported 'car-disposal' impacts: 4% of FFCS users (11% of those reporting any impacts) indicated that they disposed of a private car that they previously owned as a response to FFCS availability, and the remaining 2% (6% of those reporting any impacts) indicated that they plan to dispose of a private car during the three months following their survey participation.

4.3. Types of activities accessed via free-floating carsharing

The most commonly reported usage of FFCS (also in Table 2) was 'in addition to other means of transport (e.g. public transport): 51% of FFCS users reported using FFCS for this purpose. This was intended to describe use of FFCS as a 'last-mile' connection as part of multi-leg multimodal journeys; we advise caution with respect to this specific result, however, as this question wording is ambiguous and it is plausible that some subset of customers interpreted it to refer to use of FFCS as part of a lifestyle where FFCS is used 'in addition to other means of transport' such as public transport, rather than specifically as part of multi-leg multimodal journeys. The next two most frequently-reported purposes of FFCS usage were to visit friends/relatives (48% of users), and to go shopping (40%). Survey respondents also indicated their frequency of use of various forms of transport; Table 2 shows that the largest share of survey respondents indicated using the London Underground (86%) sometimes or regularly during the month prior to the survey, followed by buses (81%) and National Rail trains (60%).

4.4. Differences associated with car ownership impacts

The three right-most columns in Table 2 compare the profile of FFCS users who reported that their car ownership was impacted with users who did not report impacts. Of these two groups of FFCS customers, it can be seen that survey respondents reporting car ownership impacts:

- are *less likely* to be educated beyond the GCSE level (86% vs. 96%, p=0.01),
- tend to live in households with a *lower* level of car ownership (0.39 vs. 0.60 cars/household, p=0.01),
- are *less likely* to report using FFCS 'in addition to other forms of transport' (41% vs. 56%, p=0.01),
- are *more likely* to report using FFCS to perform shopping activities (50% vs. 34%, p=0.01)
- are *more likely* to report using buses (87% vs. 77%, p=0.03), FFCS (69% vs. 53%, p=0.01), and round-trip carsharing (39% vs. 29%, p=0.08) *sometimes* or *regularly*
- are *less likely* to report using private cars *sometimes* or *regularly* (19% vs. 41%, p=0.01)

4.5. Car ownership and activity-participation via free-floating carsharing

The final descriptive analysis is shown in Figure 2, which compares the types of activities in which survey respondents reported participating, disaggregated by respondents that live in car-owning households versus non-car-owning households. Respondents living in non-car-owning households were more likely to report using FFCS for shopping purposes (46% vs. 30%, p=0.01), whilst the opposite was true for using FFCS to attend business meetings (5%

vs. 14%, p=0.01). All other differences shown in Figure 2 are not statistically significant at the p<0.10 level.

4.6. Multivariate analysis of car ownership impacts

Table 3 presents results from the two logistic regression analyses undertaken in this study. In Model #1, the dependent variable is whether or not a respondent reported that availability of FFCS had any impact on their car ownership. Model Run #2 includes in the estimation sample only those reporting car ownership impacts, and analyses the difference between 'deterrence' of car ownership and 'disposal' of private cars (the latter specified as the reference category) that either were previously or are currently owned (this distinction is discussed in the last paragraph of Section 3). We present two specifications of both models: a full specification of each in which all independent variables are entered, and a restricted specification of each in which only variables that were statistically significant at the p<0.10 level are retained. Results from the 'restricted' specifications are described in the remainder of this paper, and all effects discussed are significant at p≤0.05 except as noted. It can be seen that overall goodness-of-fit is better for Model #2 (adjusted rho^2 = 0.42) than for Model #1 (adjusted rho^2 = 0.14).

The results from Model #1 show that having educational qualifications beyond the GCSE level (typically completed at age 16 in the English educational system) was negatively associated, net of confounding effects, with car ownership impacts, and the same was found with respect to one's level of household income. Put another way, education level and income level were both associated with maintaining (rather than changing) one's car ownership level (p=0.09 with respect to income level). The opposite was found with respect to living with children: the presence of children in a respondent's household was positively linked with car ownership impacts. Using FFCS 'in addition to other transport means' was negatively associated with car ownership impacts, while the opposite was true (at p=0.06) for using FFCS to attend business meetings. Finally, using buses and FFCS sometimes/regularly (as opposed to never/rarely) were both found to correlate positively with car ownership impacts, whereas use of National Rail services (at p=0.06) and private cars were associated *ceteris paribus* with a lower probability of reporting car ownership impacts.

Model #2 analyses the distinction between FFCS users being deterred from purchasing an additional car and disposing of a car that they either currently own (or recently owned). Table 2 shows that the only statistically-significant demographic effects were associated with car ownership and the presence of children: both are positively associated with being 'deterred' from car ownership rather than 'disposing' of a car. Using FFCS for shopping activities is, by contrast, associated with car 'disposal' (at p=0.07), as is using the FFCS service sometimes/regularly (at p=0.09). Finally, being a non-user of private cars (i.e. not reporting sometimes/regular usage of private cars) was found to be associated with being 'deterred' from car ownership due to FFCS availability, rather than 'disposing' of a car.

5. Discussion and Conclusions

This study aimed to establish the relationships between deciding to change one's car ownership level in response to joining a free floating carsharing service and a range of socio-demographic and behavioural factors. Two sets of analyses were undertaken: a comparison of respondents reporting any-car-ownership-impacts versus those reporting no such

impacts, and a comparison between respondents indicating that an increase in their car ownership was ‘deterred’, in contrast to those indicating that they either recently disposed of (or soon will dispose of) a car.

In order to gain access to on-street parking spaces, FFCS systems typically require mutually-agreed arrangements with the public sector entity that is entrusted with responsibility for managing street space. Such arrangements may either be ad-hoc in codifying terms-of-access for a single operator (e.g. Graham 2011), or generally-applicable to any entity that wishes to operate a FFCS service (e.g. District of Columbia, 2011). In both instances, however, the public entity must actively make policy decisions regarding terms-of-access and price. The challenge is that the evidence in the public domain regarding the impacts of FFCS is embryonic, rendering it difficult to make informed policy decisions. The findings that we present here are therefore intended to extend this current state of the evidence base, by reporting the first assessment of the socio-demographic and behavioural correlates of FFCS’ car ownership impacts. A defining characteristic of this study is that at the time the survey was conducted the FFCS was relatively early in its operation (operations had commenced three months prior). Therefore, further research will be required to determine the extent to which the findings are transferrable to contexts in which FFCS have been operating for longer periods, or are limited to the specific context of ‘early adopters’ that was the focus of this study.

We found that a lower level of household income level relative to other users is associated with both a higher probability of a FFCS user reporting car ownership impacts, and also having ‘disposed’ of a car as opposed to ‘deterred’ from acquiring a private car . This suggests that, all else equal, among users, FFCS is more likely to serve as a substitute for car ownership among households that are lower on the income distribution, and vice versa for households with higher incomes. This could indicate that households that have more limited economic resources are more likely to use FFCS to replace (rather than augment) a private car, which is consistent with microeconomic theory. However, given that users have higher income relative to the general population, this should not be interpreted in absolute terms: users who do reduce ownership have incomes that are higher on average than the population at large. It is also of note that a similar pattern was found with respect to education level: being relatively highly-educated was linked with retaining car ownership after joining the FFCS service. Reducing the parking demands of private car ownership is a common objective of urban transport policy. While our results are an initial rather than final word on this issue, they provide evidence to suggest that, for instance, targeting FFCS services at moderate-income residents is more likely to contribute to reducing private car ownership than targeting higher-income residents.

Non-car-owning households were more likely to report using FFCS for shopping purposes; one possible interpretation is that the cargo capacity of an FFCS vehicle to carry shopping is a more important characteristic for households that do not own their own vehicle. Car-owning FFCS users were more likely to use FFCS to attend business meetings (and this was found to be positively associated with car ownership impacts); it is possible that this segment of FFCS customers are using FFCS for business travel because they are not commuting by private car and therefore do not have a private car available at their workplace. No statistically-significant relationship was found between reporting impacts on car ownership and the number of cars owned by a household.

The combination of general scarcity of evidence in this domain and relevance to policymaking means that further research to document FFCS' impacts is clearly required, both regarding car ownership and other dimensions of impacts. The study reported here assessed a snapshot of a FFCS three months after service commenced. Longer-term monitoring would therefore be desirable to establish how car ownership impacts evolve as FFCS services in a given location mature, in the tradition of the body of literature compiled during the early years of round-trip carsharing in San Francisco by Cervero and colleagues (Cervero 2003, Cervero and Tsai 2004, Cervero et al. 2007). It is known that changes in car ownership tend to be associated with major life-course events (e.g. employment-status changes, marriage, birth of children; cf. Clark et al. 2014); it is therefore likely that the impacts of FFCS will evolve over time as a larger number of customers (and prospective customers) experience life-course events and as the services offered by FFCS operators themselves evolve (e.g. price levels, area of service coverage, FFCS densities and the spatial distribution of the FFCS fleet). Further research would also ideally incorporate additional pieces of information beyond those included in the present study, such as characteristics of the built environment (e.g. availability of residential parking and accessibility to various types of activity opportunities by different modes of transport) and the detailed FFCS-usage patterns of individual customers (e.g. day-of-week, time-of-day, distance of driving, etc.)

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Figures and Tables

	Berlin (simulated), Ciari et al. (2014)		**Paris (observed), 6t Bureau de Recherche (2014)**		**London (observed), Bewick et al. (2016)**		**London (simulated), Le Vine et al. (2014)**	
	Round-trip CS	FFCS	Round-trip CS	One-way Station- Based	Round-trip CS	FFCS	Round-trip CS	FFCS
Average trip duration (minutes)	27.5	20.1	N/A	N/A	6.9 hours (includes time at activity)	N/A	N/A	N/A
Average trip distance (km)	5.3 (one-way)	5.7 (one-way)	N/A	N/A	59.4 (includes both outward and return journeys, as well as any intermediate travel)	N/A	N/A	N/A
Frequency of use (journeys per user per month, except as otherwise noted)	1.1	8.5	1.5	8.5	0.8	N/A	1% modal share	3.8% modal share
Profile of journey purposes	*"[Usage of FFCS for] work [journey purposes] is substantially higher, and leisure is lower [than usage of round-trip carsharing]"*		*"For the [round-trip] service, there is also a predominance of recreational uses, including visits to relatives, purchases and outings. However, unlike the [one-way] service, commuting journeys are the least frequent"*	*"The main reason for using [one-way station-based carsharing] is visits to family/friends, followed closely by outings (sport, culture, nature). After recreational purposes...6% of users use it daily/almost-daily [for commuting] and 32% often [for commuting]"*	*"Leisure (44%), personal business (34%) and shopping are the most popular [round-trip] journey purposes"*	*"The most common journey purpose for [FFCS] is personal business (27%)"*	*"Survey respondents selected the [FFCS service] for commuting much more intensively [frequently] than round-trip CS; respondents primarily selected the latter for shopping journeys"*	

Table 1: Summary of previous studies comparing usage patterns of round-trip and one-way carsharing

	Mean value (Amongst all survey respondents), 95% Confidence Interval in brackets	Mean value (Amongst all residents of the FFCS service area)	Mean value (Amongst 'car ownership-not-impacted) group)	Mean value (Amongst 'car ownership-impacted) group)	Is difference statistically significant at p<0.10?
Female gender	11% (±3%)	50.4%	11%	12%	--
Age	33.6 (±1.0)	33.9	33.5	33.7	--
Holds a post-GCSE qualification	93% (±3%)	33%	96%	86%	Yes (p=0.01)
Single-adult household	31% (±5%)	34%	31%	31%	--
Number of private cars owned by household	0.56 (±0.08)	0.55	0.60	0.39	Yes (p=0.01)
Income (GBP/year)	£46.0K (±£2.5K)	£35.7K	£47.4K	£43.5K	--
Presence of children (under age 16) in household	35% (±5%)	29%	33%	39%	--
The number of cars I own didn't change during the last three months.	63% (±5%)	--	--	--	--
I decided not to buy a car during the last three months. ('deterrence' of car ownership)	30% (±5%)	--	--	--	--
I got rid of a car during the last three months (car disposal)	4% (±3%)	--	--	--	--
I will get rid of my own car in the next few months (car disposal)	2% (±2%)	--	--	--	--
Uses FFCS …					
…in addition to other transport means (e.g. public transport)	51% (±5%)	--	56%	41%	Yes (p=0.01)
…to visit friends/relatives	48% (±5%)	--	47%	50%	--
...to go shopping	40% (±5%)	--	34%	50%	Yes (p=0.01)
…to go out for dinner/drinks (e.g. bars, restaurants)	32% (±5%)	--	31%	33%	--
…to travel between work and home	18% (±4%)	--	18%	18%	--
…to attend business meetings	9% (±3%)	--	7%	11%	--
…to attend [generic] events in the city	9% (±3%)	--	11%	7%	--
…to attend art/cultural events (e.g. concerts, exhibitions)	8% (±3%)	--	10%	6%	--
…to go to the cinema	8% (±3%)	--	9%	7%	--
…to take part in sport activities	6% (±3%)	--	6%	7%	--
…to participate in other activities	7% (±3%)	--	7%	7%	--
Uses London Underground (metro train) sometimes or regularly	86% (±4%)	--	87%	83%	--
Uses buses sometimes or regularly	81% (±4%)	--	77%	87%	Yes (p=0.03)
Uses National Rail trains sometimes or regularly	60% (±5%)	--	62%	56%	--
Uses FFCS sometimes or regularly	59% (±5%)	--	53%	69%	Yes (p=0.01)
Uses rental cars sometimes or regularly	44% (±5%)	--	44%	43%	--
Uses bicycle(s) sometimes or regularly	37% (±5%)	--	37%	39%	--
Uses private cars sometimes or regularly	33% (±5%)	--	41%	19%	Yes (p=0.01)
Uses round-trip carsharing sometimes or regularly	32% (±5%)	--	29%	39%	Yes (p=0.08)
Uses taxis sometimes or regularly	23% (±4%)	--	22%	25%	--

Table 2: Descriptive statistics of sample (n=347), with comparison of mean values between respondents reporting impacts on their private car ownership and respondents not reporting car ownership impacts

	Model #1: *Any* car ownership impacts (All effects tested)	Model #1: *Any* car ownership impacts (Only Significant Effects)	Model #2: *Deterrence* of car ownership, as opposed to *disposal* of a car (All effects tested)	Model #2: *Deterrence* of car ownership, as opposed to *disposal* of a car (Only Significant Effects)
Intercept	0.512	0.591	7.80	4.84
Female gender	-.243	--	-1.25	--
Age	-4.82e-4	--	0.254	--
Holds a post-GCSE qualification	-1.33**	-1.31**	-0.294	--
Single-adult household	-.176	--	-3.80**	--
Number of private cars owned by household	-.119	--	-4.61**	1.37**
Income (thousands of GBP/year)	-0.00145*	-0.00111*	-0.00158*	--
Presence of children (under age 16) in household	0.589*	0.60**	11.48**	2.78**
Uses FFCS …				
…in addition to other transport means (e.g. public transport)	-0.543*	-0.57**	2.58	--
…to visit friends/relatives	0.134	--	3.37	--
...to go shopping	0.438	--	-6.72**	-1.58*
…to go out for dinner/drinks (e.g. bars, restaurants)	-0.024	--	4.02	--
…to travel between work and home	-0.491	--	9.20	--
…to attend business meetings	0.990*	0.88*	-2.10	--
…to attend [generic] events in the city	-0.099	--	-1.21	--
…to attend art/cultural events (e.g. concerts, exhibitions)	-0.608	--	4.40	--
…to go to the cinema	-0.357	--	-0.598	--
…to take part in sport activities	0.358	--	9.89	--
…to participate in other activities	-0.047	--	4.67	--
Uses London Underground (metro train) sometimes or regularly	-0.101	--	3.40	--
Uses buses sometimes or regularly	0.611**	1.13***	-5.26	--
Uses National Rail trains sometimes or regularly	-0.577*	-0.54*	1.21	--
Uses FFCS sometimes or regularly	1.23*	0.55**	-4.12**	1.65*
Uses rental cars sometimes or regularly	-0.076	--	2.40	--
Uses bicycle(s) sometimes or regularly	0.403	--	0.808	--
Uses private cars sometimes or regularly	-1.12***	-1.28***	-15.81**	-3.79***
Uses round-trip carsharing sometimes or regularly	0.243	--	3.26	--
Uses taxis sometimes or regularly	0.120	--	5.71	--
McFadden's adjusted rho^2	0.16	0.14	0.65	0.42
Sample size	n=298	n=298	n=109	n=109

Table 3: Estimation results from binary logistic regression models. *, **, and * denote p<0.10, p<0.05, and p<0.01, respectively.**

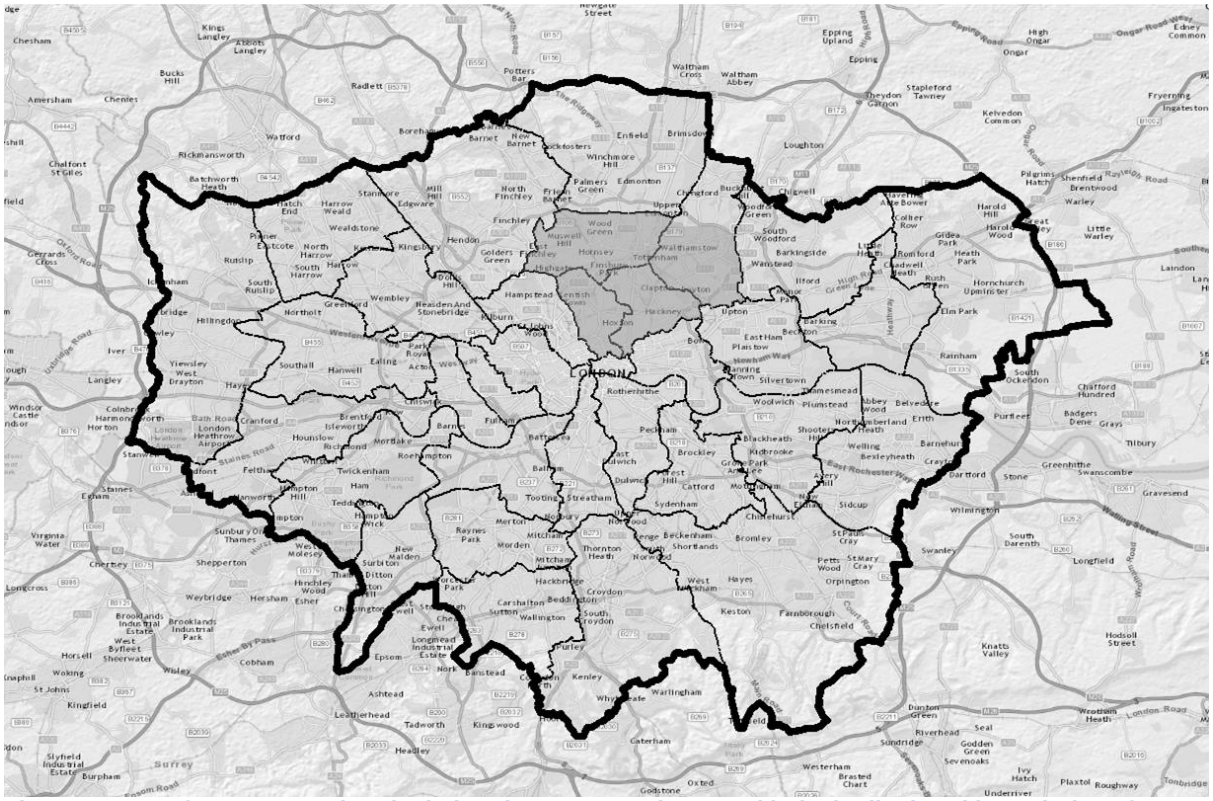

Figure 1: Map of Greater London depicting the FFCS service area (dark shading) and boundaries of London boroughs.

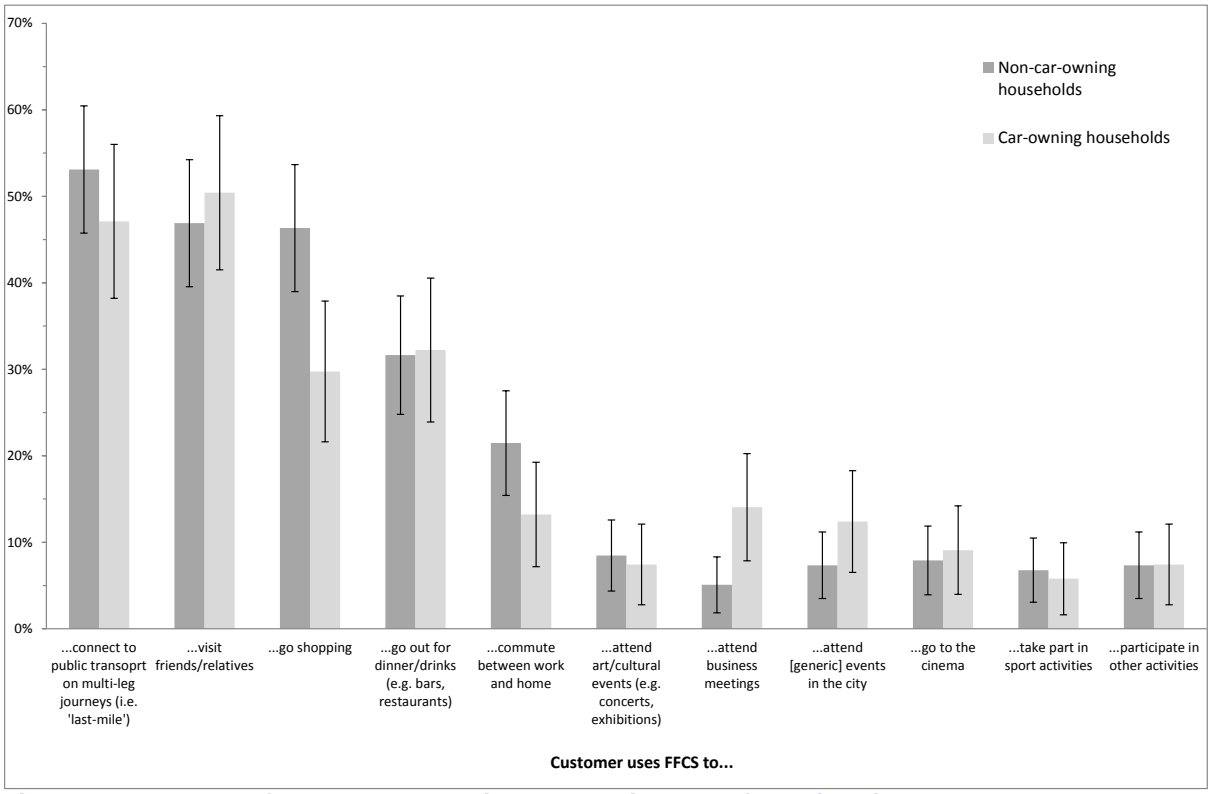

Figure 2: Percentage of FFCS customers that report using FFCS for various journey purposes, disaggregated by customers living in car-owning and non-car-owning households. 95% confidence intervals shown.