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Drivers of Car Ownership in a Car-Oriented City: A Mixed-Method Study

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Abstract: This paper presents a mixed-method analysis of car ownership in Reykjavik, Iceland, a location with a high motorization level and deeply rooted car culture. We utilize qualitative interviews to understand vehicle possession reasons and elaborate the study with statistical analysis using a softGIS survey dataset with characteristics of the respondents and their residential location. We focus on adults aged 25 to 40, who are suggested to be less car-oriented than older generations. We also describe the historic development of Reykjavik's car culture to give a perspective for the findings. We show that even among the studied age group, car ownership is still seen as a social norm, with few even seeing it possible to live without a car, and the public transport system is seen as giving a poverty stigma. However, we still find an increasing share of car-free households towards the city center. Still, the built environment impact is limited to the city center, which has a higher proportion of small adult-only households residing in shared apartments than other areas. Moreover, there seems to be a three-fold connection between having a child, acquiring a car (if not already possessed), and choosing a suburban residential location. Some indications of residential self-selection related to car ownership were found, but pro-car attitudes and residential location independently influenced car ownership. This study helps to understand the reasons for high car dominance and supports designing policies to reduce car-dependency, not just in Reykjavik but also elsewhere.

Keywords: car ownership; car-oriented mobility culture; transit-oriented development (TOD); built environment; residential self-selection; mixed-method study

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1. Introduction

Reducing greenhouse gas (GHG) emissions from private vehicles has become a critical global climate change mitigation target [1]. Following Ewing et al. [2], this can be achieved in three ways: (1) by improving vehicle fuel economy, (2) by reducing the GHG content of fuels, and (3) by reducing vehicle kilometers traveled (VKT). The first two can be labeled as "sustainable mobility", and the third as "sustainable urbanism" [3] and be divided further into two: reducing VKT while possessing vehicles and lowering vehicle possession rates. It has also been claimed that due to the high production-phase emissions, just reducing VKT is not enough, but that car ownership must go down as well [4]. In this study, we focus on the "sustainable urbanism" option, and particularly on the component of car ownership. We look at the issue both from the perspective of the urban structure impact as well as societal and personal reasons to possess vehicles.

The theoretical perspective taken in this study includes both human agency and the influence of structural conditions, such as social structures and discourses (e.g., through social norms) and the built environment, which operate at different levels of complexity [5]. The built environment and transportation infrastructures are also socially constructed through discourses and practices related to urban planning, infrastructure development,

public policies, industries, etc. [5–7]. These influences result (with a considerable time-lag) in emergent urban structures (e.g., distances between locations, access to public transportation, parking provision), which then influence human action (e.g., daily travel behavior or car purchase) and social structures (e.g., bus system reputation, the normalcy of car ownership).

The urban structure impact on car ownership has been widely studied [8]. Several studies have found a high correlation between transport energy use and density [9–12]. Typically, it is claimed that this is not only correlation but causality, partially due to shortening distances and partially due to car ownership reduction, e.g., [12,13]. Newman and Kenworthy [10] found that transport energy use grows exponentially below a threshold of 30 inhabitants per hectare. Still, after that, the impact is reduced, and above 90, there is only a marginal impact. In a similar vein, Newman et al. [14] suggested universal thresholds of >100 inhabitants per hectare for pedestrian-oriented, 35–100 for transit-oriented, and <35 for car-oriented city structures, which means radius sizes of <2 km, <20 km, and <40 km, respectively. Such findings follow the typically detected decreasing trend in car ownership towards the city center [9]. They are also in line with the suggested universally consistent travel time budgets, e.g., [15]. Many authors suggest that the built environment impact is substantial, and planning highly influential in reducing car ownership [16]. In contrast, others have suggested that the built environment impact is overestimated due to the self-selection effect of those preferring car travel residing in locations supporting car possession [9,17,18]. A confounding factor is the learning curve following exposure to a new type of urban structure after a move or development [19].

However, it is not only density and distances, but road capacity also plays a significant role in shaping the dominant archetypes [20]. More road capacity leads to improved auto conditions and increased usage, further demand for capacity, and as the final result, a strong auto-orientation [21]. Vice versa, residents of regions planned as pedestrian- or transit-oriented have been found to start behaving following the urban fabric type [14,20]. However, previous car ownership has been a significant predictor of current car ownership [22]. McIntosh et al. [20] categorized cities into motorization-oriented and traffic-limiting archetypes and found nearly 50% lower car-use rates in the latter than in the former. Besides, Cao et al. [12] found more green spaces to reduce car ownership and use, although the impact was weak in their study.

Urban rail has been suggested as a critical factor in shaping transit-oriented structures [11,21], but mainly connected to the travel time factor [11,23,24]. Therefore, bus rapid transit (BRT) systems have also been found influential [23,25], particularly systems mimicking rail in rapidness and frequency. Overall, ceteris paribus, if one can more easily access his/her desired destinations without a car, he/she is less likely to have one [26]. This effect can be achieved in two ways: improving buses' infrastructure or improving buses' competitiveness when using the existing shared infrastructure [23]. Similarly, supported by policies and infrastructure development, well-known bicycling cities of Amsterdam in the Netherlands, Copenhagen in Denmark, and Münster in Germany have all seen rapid growth rates in cycling, up to it becoming the dominant travel mode with shares of close to 50% in all these cities [27]. This development inherently relates to cycling's general competitiveness compared to other modes [28]. Shared cars and mobility-as-a-service can become an influential factor as well [4,29], but so far empirical evidence of their efficiency in affecting private car-ownership is thin [29].

It is not just the factual public transportation service level that matters, but its perception and evaluation of the system overall [30]. However, if only the image is improved and the service is inadequate, it can backfire and lock in people's decisions to use cars if they try public transport and become disappointed [31]. Even for city residents who already use public transportation, their perception of value, satisfaction, and service quality affects the likelihood of continuing their use and recommending it to others [32].

The choice between a car and other modes and between possessing a car or not is also shaped by many socioeconomic factors unrelated to the urban structure or other modes'

competitiveness. Income has a strong impact between low and middle incomes on their motorization level [33,34], but at higher-income levels, car ownership's income elasticity diminishes significantly [19,21,35]. Economic growth and rising incomes have very recently changed the mobility cultures completely from active and public transport orientation to car travel orientation in developing countries such as China [34] and Mexico [33]; but, for example, in the affluent Nordic countries, for the majority of the population income may not be a decisive factor anymore in choosing whether to possess and use a car or not [12]. The life course situation, and changes therein, have been suggested as influential factors, e.g., having a child leading to car purchase [36,37], and affecting the residential location choices [36]. Socioeconomic and urban structural factors can also simultaneously affect car ownership, e.g., by forcing lower-income residents to the outer suburban areas with weak transport options without a private car [38]. The social significance of car ownership also plays an important role [39], including cultural, emotional, and symbolic perspectives [40,41].

The car's social and cultural meanings are connected to changes in land use, urban form, transport infrastructure, and more broadly, the whole system of automobility, also related to automotive and oil industries [7,42]. All these factors together create conditions for car dependence [6], car addiction [43], and a lifestyle lock-in [39] on individual and societal levels.

Mattioli et al. [6] define a car-dependent transport system as "one in which high levels of car use have become a key satisfier of human needs". The infrastructures, regulations, discourses, practices, and lifestyles related to mobility constitute "urban mobility cultures" [7]. Its specific type, an "auto-oriented mobility culture", is likely to result from a "vicious cycle" of suburbanization, road expansion, motorization, and deteriorating conditions for and reputations of other travel modes. The cultural and social importance of cars and their possession due to their status symbol value reduces the potential impact of changes in the built environment. Understanding the cultural aspects of car ownership is essential in designing effective measures to reduce car dependence [44].

In this study, we investigate car ownership in the Capital Region (Reykjavik) of Iceland, a strongly car-oriented location with car ownership nested in the culture, and with extremely high ground transport emissions in global terms [45], but with an ongoing transit-oriented development (TOD) plan [46]. We aim at answering two research questions (RQ):

- RQ1. How strong is the impact of residential location on car ownership, compared to socio-demographic characteristics and attitudes?
- RQ2: What might explain the high car ownership rate in Reykjavik?

We first look at the historical development leading to the current situation, the development of the car culture, and then study the factors currently explaining car ownership. The quantitative analysis focuses on RQ1, whereas RQ2 is the focus of the qualitative part. The discussion section brings together the explanations provided by the two methods.

The novelty value of the study consists of three items. First, this is a study of a location with a very high car ownership level, rooted in the history of cars as status symbols and the built environment development oriented to car-dominated mobility culture across the whole modern history. Second, we look at three different levels of factors affecting car ownership, the societal level, the built environment impact, and the personal reasons to possess or refrain from possessing cars. Third, we utilize a relatively rarely used mixed-method approach with a combination of qualitative interviews to understand reasons and underlying mechanisms for car ownership [12,36,47], and survey data to detect the broad patterns and connections. Together, these two approaches can detect self-selection and reveal causality [12,13,30,48,49].

Besides, we focus on the segment of adults aged 25 to 40. It has been suggested, based on empirical evidence from global cities, that there is a maximum car ownership rate after which it no longer increases [11,50,51], and that it would be the millennial generation in the developed countries to whom cars are no longer status symbols and car culture is undesirable [52], and who are more interested in urban living and arranging their lives so

that cars are not needed [11,36,53,54]. While in Reykjavik, the driver's license possession rates are declining among the younger adults' segment [55], and a far higher percentage of trips are taken by private vehicles among residents aged 45–64 than any other age group [55], we will show that car ownership is still a social norm, which, together with low perceived quality of the public transport system, feeds into the current very high car ownership level, even among younger people. The built environment characteristics play a role, but the impact is limited to the immediate city center where car ownership is disincentivized, e.g., through limited parking space supply, and other means of travel are better incentivized than elsewhere in the region. Preference for cars as a travel mode influences the car ownership rate independently of the residential location.

2. Case Study

2.1. The Reykjavik Capital Region

The study covers the Reykjavík Capital Region (in this paper called Reykjavík), including the municipalities of Reykjavík, Kópavogur, Hafnarfjörður, Garðabær, Mosfellsbær, Seltjarnarnes, and Kjósarhreppur, which form a continuous urban fabric with joint transport planning and de-carbonization strategies. The region's population is slightly below 230,000, almost two-thirds of the overall population of Iceland. The urban structure is loose and car-oriented [56,57], except for the immediate downtown area [58]. Car access to the city center is not limited, except for a few pedestrian streets where car traffic is restricted. The public transport system consists of buses only, operating on shared lanes with cars, as there are only 4 km of priority lanes in the whole city. A bus rapid transit (BRT) system is planned but has not been implemented yet, as of 2020 [59]. A relatively high proportion of residents live in a car-oriented urban structure with weak public transport service levels [58]. Since 2010, the City of Reykjavik has had cycling policies that supported the expansion of dedicated cycling infrastructure [60], followed by an increase in cycling mode share [61]. However, the cycle lane network is still relatively short and disconnected, and only 5% of trips in the region are taken with bicycles [57].

2.2. Car-Oriented Mobility Culture in Reykjavík

The current strongly car-oriented mobility culture is a result of development over the past 60–70 years. During this time, cars gained a strong position supported by car-oriented planning, resulting in a city with a predominantly car-oriented urban structure following the classification of Newman et al. [14].

The first car was imported to Reykjavík in 1904 [57]. However, car ownership did not see a significant rise until around the mid-20th century [56]. In 1930, there were around 800 vehicles. Fifteen years later, they had doubled, and by 1960 there were 7000 cars on the streets of Reykjavík. No railway was ever built in Iceland, but in 1931, the first bus was introduced. However, a focus on the private vehicle had already begun to surface at that time, with the Reykjavík Municipal Plan of 1936 having highways distinguished from residential streets [57].

The Reykjavík Municipal plan of 1962–1983 significantly increased car dependency and urban sprawl. Although such ideas were already being criticized in many other European cities, the plan was hugely inspired by modernism and concepts such as the garden city [62]. It had a strong focus on separating work from home areas and on detached house dominated suburbs. Homes were placed further away from the wide streets that left large land areas unused, further contributing to urban sprawl [56]. It was the first plan to include traffic models, predicting that every home would have a car. Five years before the planning period was over, bus passengers had halved while car ownership had tripled [62].

Zoning was still a focus in the Reykjavík Municipal plan of 2001–2024. Local stores were wiped out with supermarkets and malls, placed along highways at the neighborhoods' outer edges, further increasing car dependence. The location also made it impossible for the malls to become lively and walkable neighborhood centers [56]. The car was still the focus of this new plan, and it predicted that by 2024, personal vehicle traffic would increase

more than the population would. It accommodated for that rise in traffic and took no other transport modes into account [62]. While some members of the public voiced their concerns about the prioritization of the car, and a trend was emerging among young people to live centrally, it was becoming evident that people could no longer live in Reykjavík without possessing a private vehicle [56].

For the first time in Reykjavik's planning history, the current municipal plan for 2010–2030 focuses on densification, mixed land use, and sustainable transportation [46]. Despite this, private vehicles' ownership and use are still increasing [63]. The current car ownership rate is exceptionally high, with the number of cars reaching 707 per 1000 inhabitants, up from 573 in the year 2000 [63], and much higher than the EU average of 516 [64]. There are approximately two private vehicles per household in Reykjavik. These numbers are similar to or higher than those in some well-known auto-oriented cities in the US, such as Los Angeles, Phoenix, or San Diego [65]. Infrastructure development has supported this change, showing, e.g., in the number of parking places going up at an even higher pace. The vast majority, i.e., about 74%, of all trips in Reykjavik, were taken with private cars in 2019 [55]. Shares of other modes in 2019 were 5% for buses, 5% for cycling, and 14% for walking [55].

Existing studies on young drivers in Reykjavik highlight how being able to drive a car provides them with feelings of freedom and independence and is perceived as necessary means of control over one's movement in space [66,67]. Driving also helps to avoid social exclusion and maintain social status, as it is part of socializing practices, and taking the bus is criticized as impractical and uncool [66,67].

3. Materials and Methods

We apply a mixed-method approach, in which a qualitative study followed a quantitative one. The studies were conducted in a sequence, meaning that the quantitative analyses' results informed the qualitative phase's research design and participant sampling (Figure 1). However, the interpretation was done in parallel, and insights from the two data sources complement each other.

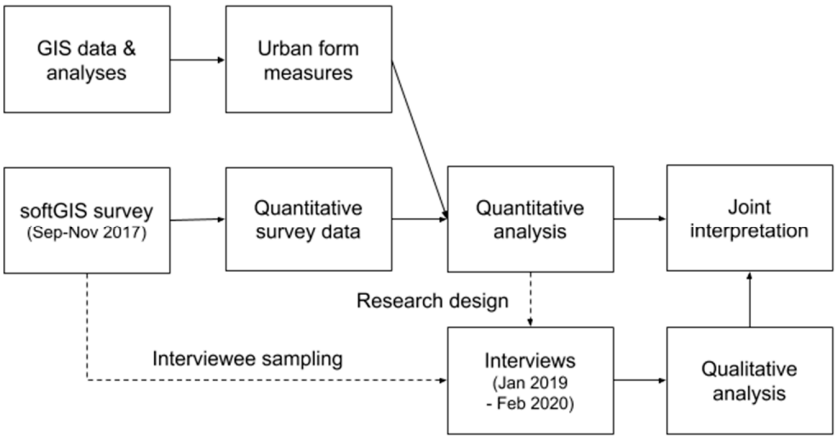


Figure 1. Research workflow.

3.1. Quantitative Data Collection and Sampling

The quantitative data were collected with an online survey between 12 September and 7 November 2017, in Icelandic, English, and Polish. The survey utilized the softGIS method, which brings together traditional online questionnaires and interactive maps, enabling marking locations by participants and answering questions related to each location [68]. Data from the questionnaire have been previously utilized in several publications and are explained in more detail in them [45,49]. The survey was targeted to all residents of Reykjavík of ages between 25 and 40. The Registers Iceland drew a geographically stratified random sample of 6000 across the capital region's municipalities on 1 August

2017. Invitations were sent in two rounds as conventional letters to individual recipients, of which 5184 invitations were delivered and 686 answers were received, resulting in a response rate of 13.2%. Because of missing answers to some of the questions, some analyses include a lower number of cases. The sample was assessed for socio-demographic and spatial representativeness [69]. Downtown residents were slightly over-represented, and suburban residents under-represented. The geographical distribution of participants' homes is presented on a map in Figure 2 and the socio-demographic structure of the sample is available in Table 1.

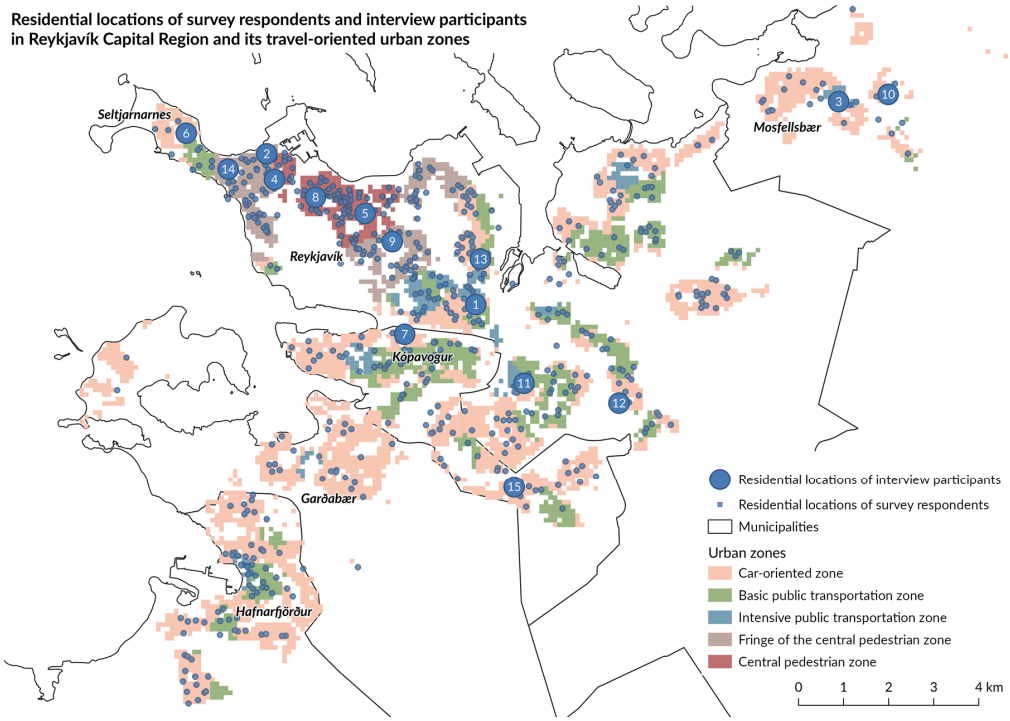


Figure 2. Home locations of survey respondents and interviewees within Reykjavik.

3.2. Variables

The outcome variable used in the study is a binary indicator of whether there is at least one car in the household (question wording: "How many cars are there in your household?"). A set of socio-demographic variables was tested for associations with the outcome variable, and the most relevant were used in further analyses: household type, age, language used to fill out the survey, monthly household income in ISK per consumption unit, and access to a cabin away from the city. Groupings of the variables and the prevalence of respondents with or without a car in the household in each group are presented in Table 1. Attitudes and preferences were elicited using 34 statements with answers on five-step Likert scales ranging from "Strongly disagree" to "Strongly agree". The answers were analyzed using principal axis factoring with oblique rotation, whose results are described in the Supplementary Information section and presented in Tables S1 and S2. Three factors were used in further analyses. The *preference for suburban residential environments* factor was strongly influenced by answers to statements such as "I prefer to live in a suburban neighborhood, even if it means traveling longer distances" and "If I could live anywhere, I would live in the suburbs". The *preference for a car as a travel mode* factor was influenced by answers to statements such as "The car is my preferred way of getting around the city". The *pro-environmental attitude* factor was influenced by answers to such statements as "I think about the environmental impact of services I use". Factor scores were estimated using a regression method and grouped into quartiles with low, medium, and high values.

Table 1. Car ownership rates in categorical variables.

Variable	N	Number of Cars in a Household			
		None		At Least One	
Sample (Total)	**686**	**78**	**11%**	**608**	**89%**
Income per consumption unit	631				
Low—below 375k	208	35	17%	173	83%
Medium—375k to 550k	205	27	13%	178	87%
High—above 550k	218	11	5%	207	95%
Age	686				
25–28	168	29	17%	139	83%
29–32	161	25	16%	136	84%
33–36	178	14	8%	164	92%
37–40	179	10	6%	169	94%
Household type	685				
Couple	143	15	10%	128	90%
Family	377	19	5%	358	95%
Single	94	35	37%	59	63%
Other	71	9	13%	62	87%
Survey language	686				
Icelandic	576	53	9%	524	91%
Other	109	25	23%	84	77%
Access to a cabin	678				
No	376	54	14%	322	86%
Yes	302	24	8%	278	92%
Distance band to the main city center (2 km)	685				
0–2 km	131	37	28%	94	72%
2–4 km	144	21	15%	123	85%
4–6 km	103	10	10%	94	90%
6+ km	306	10	3%	296	97%
PT access zones bus departures within a 5-minute walk from home	686				
At least 10 per h	238	47	20%	191	80%
Between 4 and 10 per h	200	14	7%	186	93%
Less than 4 per h	248	17	7%	231	93%
Travel-related urban zones	686				
Central pedestrian zone	96	31	32%	65	68%
The fringe of the central pedestrian zone	159	23	14%	136	86%
Intensive public transportation zone	82	8	10%	74	90%
Basic public transportation zone	116	7	6%	109	94%
Car-oriented zone	232	9	4%	224	96%
Suburban preference	564				
Low	188	27	14%	161	86%
Medium	188	22	12%	166	88%
High	188	16	8%	173	92%
Pro-car attitude	564				
Low	188	43	23%	145	77%
Medium	187	15	8%	173	92%
High	189	7	4%	182	96%
Pro-environmental attitude	532				
Low	178	12	7%	166	93%
Medium	178	19	11%	159	89%
High	176	31	18%	146	82%

Survey participants marked their approximate residential location on the map, which was then used to characterize the location in a geographic information system (GIS). Driving distance to the main city center from each residential location was calculated using the

Route tool in the Network Analyst toolbox in ArcMap 10 and street network data from the i50v topographic map. Respondents were then grouped into 2-km distance bands. Access to public transportation was measured as an average number of bus departures per hour at a bus stop located within a 5 min walk from home. Bus stops were divided into three classes: at least 10 departures per hour on average, between 4 and 10 departures, and below 4 departures. Areas within a 5 min walking distance (332 m) to the stops were outlined in the Service Area tool in Network Analyst in ArcGIS 10 and used to assign each residential location to an access zone. Figure 3 shows the geographical distribution of different bus accessibility zones in the study area. We have also divided the city into travel-related urban zones based on the theory of three urban fabrics proposed by Newman et al. [14], and a method applied earlier in Helsinki and Stockholm by Söderström et al. [70] and by Czepkiewicz et al. [58] in Reykjavik (Figure 3). The central pedestrian zone is a contiguous area within a 1500 m network distance from the main city center. The pedestrian zone's fringe extends further away, i.e., between 1500 m and 3000 m, from the main city center. Intensive public transportation zone is assigned to locations more than 3000 m from the main city center, which have a bus stop with at least ten departures per hour within a 5 min walk. The basic public transportation zone is assigned to locations with a bus stop with 4 to 10 departures per hour within a 5 min walk. The car-oriented zone is assigned to the remaining cells, not included in the above zones.

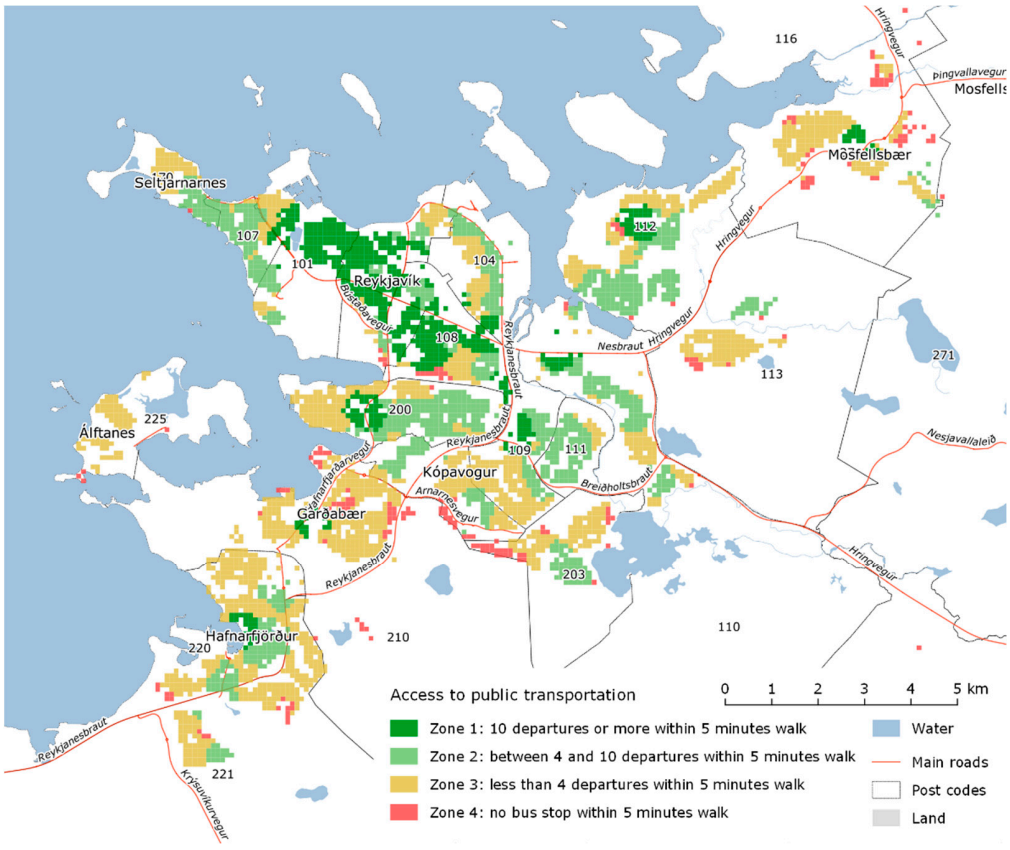


Figure 3. The geographic distribution of different access levels to public transportation is based on walking distance to bus stops and departure frequency.

3.3. Quantitative Data Analysis

We applied a hierarchical logistic regression with a logit link, using the MASS package's glm.nb function in R. Hierarchical regression is a type of regression analysis in which groups of variables are sequentially added to a model to statistically control their effect and to see whether adding them significantly improves the model's predictive power. Choosing

this method was motivated by the wish to assess the extent to which car ownership is explained by different kinds of factors. First, we estimated models with only residential location characteristics as predictors (Model 1). Then, we added socio-demographic variables to the predictor list (Model 2). Finally, we added attitudes and preferences (Model 3). We then compared the odds ratios, Tjur [71] pseudo R2 values (coefficients of discrimination), and the Akaike Information Criterion (AIC) between different model versions. Models including access to a cabin and suburban preference were also tested, but these variables did not contribute significantly and were removed from the final version. None of the predictors correlated strongly with each other, except for the suburban preference and the distance to the city center. The VIF statistic in the final models was lower than 2 for all variables. Therefore, the models had no issues with statistical multicollinearity.

3.4. Qualitative Data Collection

The qualitative data collection employed the method of semi-structured interviews. An interview protocol was created, informed by previous literature and findings from the preceding survey study [45,49]. The protocol was tested and improved through a sequence of pilot interviews, 9 in total. Three rounds of email invitations were sent to those survey participants who had expressed willingness to participate in an interview afterward and had provided their email addresses. Finally, 15 interviews took place between January 2019 and February 2020, each lasting 45 to 90 min. The interviews were conducted in a place chosen by each respondent: the researchers' office, a café, or the respondent's home. Two researchers were typically present in each interview, but only one researcher conducted a few latter part interviews. Five interviews were conducted in English, one in Polish, and the rest in Icelandic. When English was the language, it was typically not the native language of neither the interviewee nor the researchers. Before the interviews were set up, we received assurance from the interviewees that they felt comfortable expressing themselves in English. The Polish and Icelandic interviews were conducted in the native language of both the interviewee and the researcher leading the interview. At the beginning of each interview, consent was asked after describing how the data would be utilized. Each interview was recorded, and the audio files were transcribed, and those taken in other languages than English (Icelandic and Polish) were translated into English. The interviewees' home locations are presented in Figure 2, and Table 2 presents some basic information about them.

Table 2. Basic interviewee characteristics.

ID *	Gender *	Age *	Language	Dwelling	Household Type	Car	Residential Zone **
1	Male	40	Icelandic	Apartment	Family	Yes	Basic public transport
2	Female	40	Icelandic	Apartment	Single/other	Yes	Fringe of central pedestrian
3	Male	29	Icelandic	Detached	Single/other	Yes	Sub-center pedestrian
4	Male	29	Icelandic	Apartment	Family	Yes	Fringe of central pedestrian
5	Female	29	Icelandic	Apartment	Couple	No	Central pedestrian
6	Male	41	Icelandic	Semi-detached	Family	Yes	Car-oriented zone
7	Female	40	Icelandic	Detached	Family	Yes	Car-oriented zone
8	Female	38	Icelandic	Apartment	Family	No	Central pedestrian
9	Female	37	Icelandic	Apartment	Single/other	Yes	Fringe of central pedestrian
10	Female	34	Polish	Apartment	Couple	Yes	Sub-center pedestrian
11	Female	30	English	Apartment	Couple	Yes	Central Pedestrian
12	Female	36	English	Apartment	Couple	Yes	Car-oriented zone
13	Female	42	English	Semi-detached	Family	Yes	Car-oriented zone
14	Female	27	English	Apartment	Single/other	Yes	Fringe of central pedestrian
15	Female	42	English	Other	Single/other	Yes	Car-oriented zone

* The ID, gender, and age are utilized to code the interviewees, and are utilized in the rest of the manuscript to denote each interviewee. ID1, Male, 40 is coded I1, M40, and the rest the same way. ** The zones refer to the travel zone system presented in detail in Czepkiewicz et al., [51], similar to the zoning systems used in Finland and Sweden.

3.5. Qualitative Data Analysis

We followed the two-step interpretation method explained in detail by Næss [48] in the qualitative analysis. In this study, we took an exploratory perspective, although guided by theory. The two-stages of interpretation consists of the first step, in which the researchers use a predetermined list of themes and guiding questions under each theme to interpret each interview, and the second step in which the individual interpretations are summarized to an overall holistic response to each question and further to each theme. Two researchers participated in the interpretation process. First, a researcher not having participated in taking the interviews did the interpretation, both two stages. Another researcher, having taken and transcribed the majority of the interviews, validated the interpretations. Overall, the interpretation scheme includes six themes and 22 questions, of which three themes and 13 questions were utilized in this study, as shown in Table 3. Quotes were collected and are shown to illustrate the interpretations. Under the guiding themes and questions, the interview materials were openly explored to find answers to the RQ2.

Table 3. Interpretation themes and questions.

Theme	Questions
Residential location	1. Is there an indication that travel-related reasons or motivations affected the residential location choice?
Car ownership	1. How does the respondent reason possessing or not possessing a vehicle (or several)? 2. How does the respondent describe the rationales behind choosing or possessing a vehicle with specific qualities? 3. Is there an indication of underlying societal reasons for vehicle possession or avoidance of vehicle possession? 4. Is there an indication of other underlying reasons for vehicle possession or avoidance of vehicle possession?
Mode choice	1. What are the rationales behind choosing or not choosing the car? 2. What are the rationales behind choosing or not choosing to walk? 3. What are the rationales behind choosing or not choosing the bus? 4. What are the rationales behind choosing or not choosing to cycle? 5. Is there an indication of underlying societal reasons for the mode choice of the respondent? 6. Is there an indication of underlying societal reasons for the mode choice of others?

4. Results

4.1. Quantitative Analysis Results

The rate of car ownership among study participants varies geographically in the region. The highest percentage of participants in car-free households (28%) is in the city center's closest vicinity, up to 2 km from the center. In the farther 2km bands, the rate decreases to 15% and 10% and drops sharply to around 3% above the 6 km threshold (Figure 2). Even relatively low car ownership rates are almost exclusively limited to the downtown postcode 101 (Figure S1). Access to bus service also correlates with car ownership: 20% of participants are car-free in areas with more than ten departures per hour within a 5 min. walk from home, and 7% in areas with fewer departures.

The income per consumption unit impacts ownership: among those earning less than 375k ISK, 17% are car-free, while among those earning more, only about 7%. Non-Icelanders are more likely than Icelanders to be car-free: 23%, compared to 9%. Among different household types, single people are the most likely to be car-free (37%), and families the least likely (4%). Having access to a summer house is associated with having a car in the household: only 7% of such participants are car-free, compared to 14% among those who do not have a cabin.

Unsurprisingly, those who score low on pro-car attitudes are more likely to live car-free: 23% of them live without a car, compared to 4% among those who most strongly prefer cars as a travel mode. Preference for a suburban living is more weakly associated. Pro-environmental attitudes exhibit some association, with 18% among those scoring high living car-free compared to 7% among those who score low.

There is a higher percentage of single and childless households close to the city center than in other parts of the city (Figures 4 and 5). There are differences in the distribution of other socio-demographic variables in the city, but none show clear spatial trends. There are weak clusters of low values of pro-car attitudes and high pro-environmental attitudes in the city center (see Figures S2 and S4). Both variables only weakly correlate with the distance to the city center ($r = 0.11$ and $r = -0.18$, respectively). Preferences for suburban residential environments correlate with the distance to the city center more strongly ($r = 0.44$) and cluster geographically (Figure S3), which suggests that this variable, not the attitude towards cars, is the more significant driver behind residential choices.

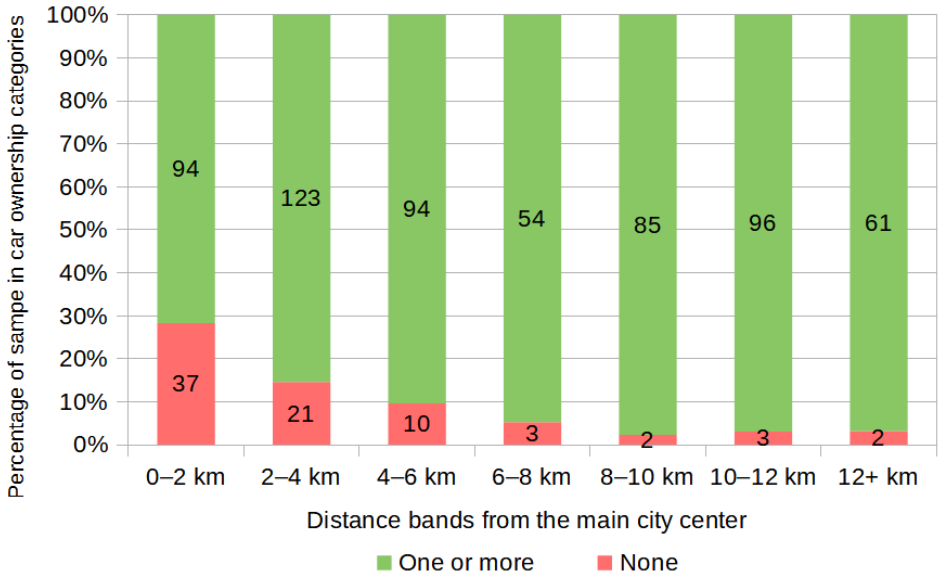


Figure 4. Car ownership among study participants living in distance belts from the main city center in Reykjavík. The numbers of participants in each category are shown as labels.

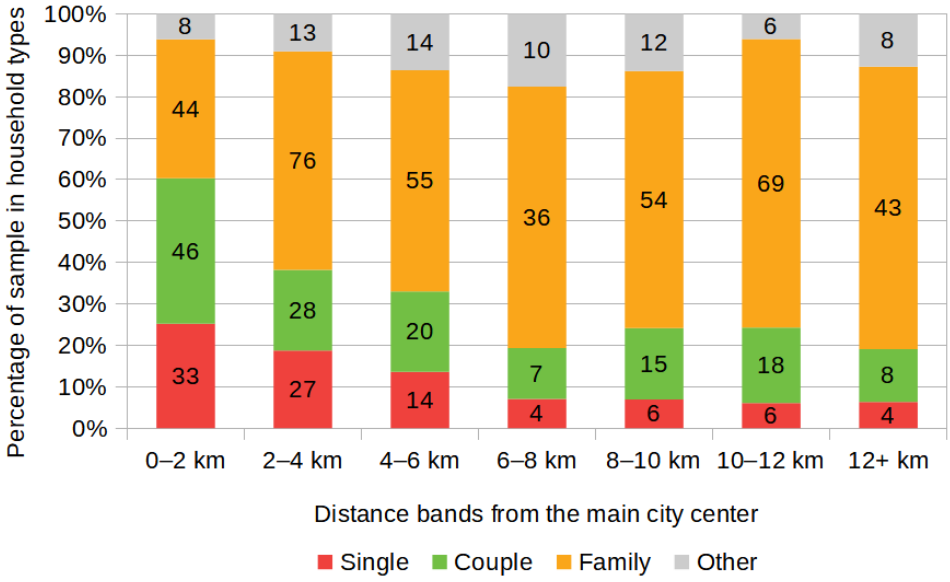


Figure 5. Household types in distance belts from the main city center in Reykjavik.

Regression analysis shows that distance to the city center is strongly related to car ownership even when socio-demographic and attitudinal variables are controlled (Table 4). The farther to the city center, the more likely the residents are to have a car. Living in an area with poor access to bus service increases the likelihood of car ownership, but the

p-value of this variable is higher than 0.1. Single people are much less likely to own a car than couples. Families with children are somewhat more likely to own a car than childless couples. Still, the variable is not significant in the model, and the strength of the relationship is not certain. Age appears to influence car ownership independently of other variables, with the oldest group (37 to 40 years old) being the most likely to own a car. Compared to those with high income, people with low and medium incomes are less likely to own a car. Non-Icelandic speakers are less likely to own a car than Icelandic speakers. Pro-environmental attitudes seem to decrease car ownership's likelihood, but their effect is uncertain in the model (*p*-value ~ 0.1). Pro-car attitude strongly predicts car ownership, independently from a residential location. Notably, the influence of the suburban residential location on car ownership was stronger after adding pro-car attitudes into the model. Two variables were tested and not retained in the final model: access to a cabin was weakly positively related to car ownership but not significant, and suburban preferences had no apparent impact on car ownership.

Table 4. The hierarchical logistic regression on car ownership (1 = one car or more, 0 = no cars in the household).

Variable	Level	Prevalence (%)	Model 1	Model 2	Model 3
			OR (CI 95%) sig *	OR (CI 95%) sig	OR (CI 95%) sig
Distance to the main city center	0–2 km	72	1	1	1
	2–4 km	85	2.19 (1.21–4.06) *	2.47 (1.2–5.25) *	2.14 (0.9–5.28).
	4–6 km	90	3.22 (1.51–7.39) **	3.37 (1.41–8.72) **	3.19 (1.13–9.92) *
	6+ km	97	9.38 (4.27–22.08) ***	9.94 (4.01–26.58) ***	12.46 (4.02–45.5) ***
Hourly bus departures within a 5-min walk	10 or more	80	1	1	1
	Less than 10	93	1.41 (0.81–2.49)	1.39 (0.73–2.67)	1.72 (0.79–3.81)
Monthly income per consumption unit	High (>550 k)	95		1	1
	Medium (375 k–550 k)	87		0.37 (0.16–0.82) *	0.43 (0.15–1.14)
	Low (<375 k)	83		0.16 (0.07–0.36) ***	0.2 (0.07–0.52) **
Age	25 to 28	83		1	1
	29 to 32	84		1.09 (0.53–2.3)	1.07 (0.44–2.66)
	33 to 36	92		1.95 (0.87–4.53)	1.86 (0.73–4.94)
	37 to 40	94		3.03 (1.24–7.89) *	5.05 (1.62–18.13) **
Household type	Couple	90		1	1
	Family	97		1.25 (0.54–2.82)	1.44 (0.55–3.7)
	Other	87		0.48 (0.17–1.41)	1.07 (0.31–4.11)
	Single	63		0.15 (0.06–0.34) ***	0.15 (0.05–0.39) ***
Language	Icelandic	91		1	1
	Other	77		0.51 (0.26–1.01).	0.74 (0.32–1.74)
Pro-environmental attitude	Low	93			1
	Medium	89			0.43 (0.16–1.09).
	High	82			0.54 (0.21–1.31)
Pro-car attitude	Low	77			1
	Medium	92			3.08 (1.37–7.31) **
	High	96			8.49 (3.22–26.15) ***
	N		685	630	482
	AIC		438	349	256
	Tjur R^2		0.090	0.253	0.360

* significance level. Significance levels in the table: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.1$.

4.2. Qualitative Analysis Results

The qualitative analysis led to the emergence of societal level potential explanations to the current very high car ownership level, personal issues, and urban structure related aspects. The societal level issues, covered in detail in the next two subsections below, are *"Car possession as a social norm"* on the one hand, and *"public transport stigma"* as the other side of the coin. After these sections, the analysis moves to an individual level and covers two subsections: *"Personal reasons for car possession"* and *"Car ownership and the urban structure"*. As the last item, we summarize our findings related to the interviewees' environmental considerations on car possession.

4.2.1. Car Possession as a Social Norm

On a general level, many respondents discussed why the car possession level in Reykjavik is so high and how people not possessing vehicles are considered by others. Based on these views, car ownership is seen as a norm in Reykjavik, and a kind of a status symbol, at least so that car-free living is considered a signal of poverty or low social status. Those who voluntarily do not possess vehicles are held as marginal and strange, even in a negative way. These examples from the interviewees' statements describe the social norm status of car ownership:

> *"Yeah, ok you have money to own a car and just live your life", I think that's like the normal thing."*
>
> (I2, F40)

> *"I think having a car, it's like the norm. If you don't have a car you're like marginal. Since maybe that you don't have the money for it . . . "*
>
> (I13, F42)

> *" . . . people that are over 30 are supposed to, you know, have a car . . . "*
>
> (I4, F27)

> *" . . . it's seen as like, you almost have to own a car to live in Iceland."*
>
> (I11, F30)

The strong social norm status of possessing vehicles might also lead to being negatively judged by society if one does not have a car, as demonstrated by three interviewees:

> *"I think people who use the bus system . . . they kind of get that stamp: 'ok, you don't have the money to own a car, or, you are a poor student' or something like that."*
>
> (I2, F40)

> *" . . . if you go for a job interview then it would be seen negatively if you don't have a car, you know, like you're not flexible."*
>
> (I13, F42)

> *" . . . people have pride in driving, and like being able not to take the bus. In Iceland, I think more than any other country."*
>
> (I14, F27)

The example of I5, F29, voluntarily not possessing a car, shows how it is considered abnormal not to have a car, and as something temporary, and not just a choice as with possessing or not possessing something else.

> *" . . . [they think that] it is sort of a situation, a temporary condition or . . . . yes I think they feel sorry for me."*
>
> (I5, F29)

Nevertheless, the interviews brought up some indication of change, although weak. The example given by I8, F38 shows how the younger adults might be the generation that is less addicted to cars.

> *" . . . the proportion of people who generally take the driver's license when they have become of age, it just, is declining very fast, and I have a son who is 18 and a half years old, and he has never thought of attending one single driving lesson, and I have never even mentioned it to him because I have no specific reason to assume that he is interested in it."*
>
> (I8, F38)

4.2.2. Public Transport Stigma

The other side of the car culture coin seems to have to do with the public transport system's public image. The perceptions of the bus system are bad, particularly among those never or seldom using the system, as put by four interviewees who themselves are at least occasional bus users:

> *"[the reputation is] Bad, which I just don't understand. But that's mainly with people who don't take the bus. . . . some people find it very strange [to travel by bus]"*
>
> (I2, M41)

> *" . . . people are just really negative towards the bus often like at my workplace there are a few that are really negative, and they're like, very loud regarding it even though they have no experience of it, just hear it from the outside . . . "*
>
> (I4, M29)

> *"I know the bus system gets a lot of hate. . . . everyone I know they can't believe I like riding the [buses]."*
>
> (I11, F30)

> *" . . . in my mind, the image of the bus is really good, but I know that it's not, hehe for others, and I, you know, I read the Internet when people are foaming with rage, over this and that."*
>
> (I8, F38)

I10, F34, and I9, F37 give examples of the perceptions among those not using buses:

> *"I don't know, but . . . I think the bus would have to be changed three times. And I don't know how it would work out in terms of time."*
>
> (I10, F34)

> *" . . . the main reason that I haven't used it here, and used it a lot abroad, is that, they, of course abroad they go every 10 minutes, you never need to wait really, . . . and, uhh, I just haven't put myself into it here, but I have just heard that there are usually 20 minutes between . . . "*
>
> (I9, F37)

I5, F29, is a car-free person for environmental reasons and tells how she avoids negative discussions about the bus system with those not using buses in the interest of not supporting the negative attitudes:

> *"I am careful that I never actually complain about the bus, except for those who also take the bus . . . Because you know, those who use the car, . . . they're just 'yeah I know, this is just miserable'."*
>
> (I5, F29)

A very strong thought seems to be that the buses are for the young, old, poor, strange, and foreign people, and those who can, have cars and drive.

> *" . . . it's like a lot of like, teenagers, and then a lot of old people, and then a lot of creepy people."*
>
> (11, F30)

> *" . . . even when they did the test of having the bus ticket for free for the people in school, they did not see a rise in people taking the bus. . . . If you take the bus, you're probably poor because you don't have a car."*
>
> (I12, F36)

> *"[the general thought is that] just the low-wage-earners, poor people and senior citizens and foreigners [use buses]"*
>
> (I8, F38)

I6, M41, goes as far as to talk about a "reputational risk", and I14, F27, about "stigma" in taking a bus, meaning getting a bad reputation if seen in a bus:

> *" . . . people find it maybe a liiiittle bit embarrassing to take the bus, . . . there is like some reputational risk hehe that accompanies it. . . . I think this is the thought, and common, common thinking."*
>
> (I6, M40)

> *" . . . there is some stigma about the bus."*
>
> (I14, F27)

4.2.3. Personal Reasons for Car Possession

Now, after looking at societal-level explanations for the prevailing car-oriented culture in Reykjavík, we move on to discuss the more specific reasons for car possession brought up by the interviewees, issues below the level of social norms and cultures. Therefore, while interpreting the reasons presented below, one must bear in mind the above discussed social norm status of cars and weak image of public transport as an alternative in Reykjavík. These issues are particularly important as these two levels are not fully separate entities but are strongly connected.

For many, car ownership is simply an issue of everyday life convenience. A car makes it faster to get to places, easier to carry large or heavy shopping, allows for less exposure to bad weather, is available at any time, and so on.

> *"Like I live my life today, I think it's more comfortable to have a car . . . "*
>
> (I2, F40)

> *"I would always have a car. . . . it's maybe also just my own mindset somehow . . . "*
>
> (I9, F37)

> *" . . . the most we use [the car] for is to buy something from the shop which we have to carry a lot"*
>
> (I3, M29)

Children are strongly connected to mandatory car ownership, just to be able to get things done. This reasoning is not far from the general convenience reason but implies stronger dependence. I6, M40, also tells how they plan on selling their second car when their youngest child goes to school and starts walking there. I4, M29, gives an example of a person against car-ownership in general, but still went to acquire one when their first child was young and expecting their second child. I8, F38, who in the interview says that she, at least nowadays, hates cars, got a driver's license and bought a car when she was pregnant, but sold it when the child was 10. These examples underline the strong connection between car ownership and bounded activities due to children, shown in the quotes below:

> *" . . . if you have children and you . . . need to drive to the playschool to pick them . . . it really doesn't work out with public transport."*
>
> (I6, M41)

> *"I just like it mainly because of the kids. I'm always on the move and either driving someone somewhere or picking up things, and this just wouldn't be easy without a car."*
>
> (I7, F40)

> *"I umm, took the driving license there sometime around the millennium. Just before the age of twenty, and, mainly did it because I was expecting a baby . . . "*
>
> (I8, F38)

According to I7, F40, car-free living is a free choice but available only to adult households without children:

> *"[car-free living i]s for the people who don't have children. I think it must be that way. It may be a choice for people who do not have children. But if you've got one and two and three kids, that's just somehow not a choice. I wouldn't understand how it works."*
>
> (I7, F40)

Cars facilitate trips away from the city, and those who value activities outside the city tend to have cars regardless of their within-city travel preferences. Of the 15 interviewees, for two such activities are important enough to be brought up as reasons to possess vehicles. I20, F27, tells how she wants to have a car for such trips but cannot afford one currently.

> *"I hike a lot. And . . . you always need to, you know, drive to the mountains. And . . . I go camping a lot. And just yeah. I need the car for those things, those activities . . . "*
>
> (I15, F42)

> *"It would be really lovely [to have a car], just if this wasn't an option, just so you can like break up your everyday life and go somewhere, you know, in Iceland?"*
>
> (I14, F27)

Two respondents say that they need to have a car for their work (I1, M40; I17, F30) and have acquired cars, particularly for work. I1, M40, still considers himself more of a car-free type of person, but I11, F30, says that now after having had a car for a while, she could not see going back to car-free living. Since it can happen to the one used to using buses, it is highly likely that in a car culture like that in Reykjavik, for many it is the case that they are used to using cars since they were children and do not see how it would be possible to live without one.

> *"I really didn't want to buy a car . . . it was really just his work that kind of pushed us into buying one, but now that we have one, I can't see us not having a car."*
>
> (I11, F30)

4.2.4. Car Ownership and the Urban Structure

We found clear evidence of self-selection in many interviews, where respondents discussed how they could not live in the city center since they want to have a car, making them feel it's too difficult in the city center due to parking fees and lack of parking spaces. Simultaneously, none of the interviewees brought it up that the surrounding urban structure or distance to the city center would be the reason to possess a car. This naturally does not mean that there would not be this typically reported relationship, and potentially the interviewees could have considered it too self-evident to bring up. However, the interviews interestingly provided rich material about the location being selected to support each respondent's travel preferences or for reasons not connected to travel preferences at all.

Generally, suburban versus city center preference was one of the key influential factors in residential location choice, closely related to preference for quietness or liveliness. As a broad picture, the preference for city center living connects to car-free living preference (I4, M29; I5, F29; I8, F38), whereas the other way round, the suburban preference connects to car-oriented travel mode preference and therefore car possession. This preference also has to do with the life course situation of the respondent; respondents from families with children seem to more often choose locations from calmer neighborhoods, like I7, F40, and I13, F42, and adult households seem to have more often a higher preference for the city center liveliness, like I2, F40, and I4, M29.

This connection between children and car possession might also partially explain car ownership differences between the city center and the suburbs. I11, F30, lives as an adult couple who are planning on having a child soon and have just moved away:

> *"I think most of the stuff to do is centered around like me like having kids and stuff like that. . . . for . . . , a younger couple without kids, there's not too much to do."*
>
> (I11, F30)

I7, F40, has lived longer in a suburb, has children and a car, and praises the child-friendliness of her suburb:

> *"Quiet and child-friendly, . . . middle-class environment . . . I think it's a good area, such a mixed social group and lots of good kids and so I like it very well."*
>
> (I1, F40)

Some respondents also directly called themselves either city-center persons (I4, M29; I8, F38) or suburban persons (I1, M40). I11, F30, is in the middle of kind of a transformation process to becoming a suburbanite instead of a city center person. She tells how she misses the downtown atmosphere now that they have moved to a suburb. Still, she considers the current location better for them as a married couple potentially having a child soon, and much easier now that they had to get a car for her husband's work (I11, F30).

> *"I do miss living downtown. . . . especially as a married couple like we're trying to have more like adult life . . . "*
>
> (I17, F30)

I14, F27 has recently moved out from the city center and does not have a car, but can borrow one almost whenever she needs to and considers that an important enabling factor for living outside the downtown. She also says that she would want to have a car of her own if she could afford it.

I8, F38, says that it was the city center's location, enabling car-free living, not the home itself, which was the important location choice factor for their family. They do not have a car, and she tells how she hates cars and would not even want to see cars around her. While she cannot quite reach that level, she is satisfied with the city center location and fewer cars around her:

> *"I can't stand cars, I preferably want never to be close to them, umm, which is another thing which is a complete luxury in [downtown]. I can walk on the street to work; I just go down one street, occasionally have to escape to the sidewalk if a car needs to get passed, but it's really calm car traffic, which I really like."*
>
> (I8, F38)

I4, M29, is a strongly city-center person with a car-free mindset, and decided to stay in the city center with a child, although nowadays anyway has a car:

> *"It was always in this area, the central area, where we could be carless, or pretty much carless, so it was very clear, . . . I would preferably not want to go, you know, far outside a downtown core, basically it depends on the further away we go the less exciting it is for me . . . "*
>
> (I4, M29)

In particular, having a designated parking space seems to be a location choice factor for some who choose calmer and outside-the-immediate-city-center locations. This is not the decisive issue for the final location choice, but can be such when choosing between the city center and the suburbs, as demonstrated by two respondents:

> *" . . . we had just purchased a car, . . . And living downtown with the car was really difficult because we had no assigned parking."*
>
> (I11, F30)

" . . . we have to have parking space as we have so many cars, so we could never go and live downtown Reykjavik . . . "

(I12, F36)

I9, F37, and I6, M41, consider it impossible to live in Reykjavik without a car with how the city design is. This kind of thinking might show in households choosing to locate to suburbs rather than to the city center if they think they need a car and consider it difficult to have a car and live downtown.

"I just feel that if you live in Reykjavik, then you need to have a car . . . "

(I6, M41)

" . . . the road system in Copenhagen is made for cars, buses, cyclists and walking, so, but here it's only made for cars . . . "

(I9, F37)

4.2.5. Environmental Considerations Related to Vehicle Possession

Environmental considerations came up in many interviews but seldom are a strong-enough factor for choosing car-free living. Only I5, F29 says that her environmental considerations are the main reason for car-free living:

"We are very environmentally conscious people. We just try to use . . . bicycles."

(I5, F29)

I8, F38, lives car-free as well, but it seems to rather be her 10-year old partially present stepson who is environmentally aware rather than the adults in the household, who mainly praise walkability and no need for a car:

"[the father] often says some nonsense like 'damn I want a pickup truck', which is never going to happen, but the child always responds with just "yes you can't count on my support in that, in that adventure ", . . . just says that it pollutes, it's disgusting . . . "

(I8, F38)

Besides, three respondents brought up pro-environmental attitudes related to their car and travel mode choices. I7, F40, and I12, F36, have purposefully chosen their current vehicles so that they are low-emitting, and I3, M29, who shares a car with other adults, but seldom uses it, says how the environmental aspect has become an important factor for him for continuing to choose other travel modes than driving. He also recognizes the importance of paying attention to the production phase emissions when choosing the car to buy.

"I have a very cheap car. Which consumes little . . . [When] I'm on this little car, [people] think "yes, . . . [s]he's not polluting much"

(I7, F40)

"It wasn't [an environmental issue] in the beginning, it was just because I don't like to drive. Right now it's mostly yes, environmental . . . if I were to buy a car now, I would definitely go for a used electric car. Not even a new electric car."

(I3, M29)

While these choices only indirectly relate to car ownership, it is an interesting nuance that I18, F36, discusses how she thinks that driving her Fiat Panda is likely not worse than taking a bus that runs almost empty. Such considerations might impact car ownership, but still, these persons show as car owners and participate in Reykjavík's car culture.

"If I drive with a Panda or if I drive in an empty diesel bus for 60 people, and it's driving empty the whole day, . . . I don't think it makes like any difference in emissions."

(I12, F36)

5. Discussion

5.1. Result Insights

This study was motivated by the urgency of reducing GHGs from transport, car ownership being one of the potential components to affect [2,3]. We investigated the reasons for the current very high car ownership level in Reykjavík, Iceland, a location with a long tradition in car-oriented planning, but with a recent TOD plan in effect, societal-level reasons, the built environment impact, and individual explanations. Whereas car ownership has been extensively studied for decades, including all these aspects, few studies have looked at locations with very high car ownership and covered all these perspectives. Besides, we used a research strategy allowing for the detection of causal relationships instead of just correlations. We applied a combination of qualitative, quantitative, and geographic information science (GIS) methods to achieve it. The study focused on the segment of ages 25 to 40, which has been suggested to value cars differently from the previous generations to whom cars still were strongly status symbols [11,36,50–52].

While we detected some voices of change, our results indicate that in Reykjavík, even among the younger adult generation, car ownership still is a strong social norm, and few consider it possible to live without a car. The explanation might lie in that younger adults are more accustomed to car ownership and car rides as the main transport mode since childhood than older age cohorts, as previously suggested by, e.g., Matas et al. [72]. High existing car ownership levels have also been found to drive future high car ownership despite changes in the demographics or built environment characteristics [69]. These are aspects of how a car-oriented culture might perpetuate itself. Simultaneously, in Reykjavík, with a strong attachment to cars, public transport is considered low quality, and low car ownership neighborhoods are virtually non-existent.

The built environment characteristics still play a role in line with the causality suggested by several previous studies in similar affluent locations [3,9,10,12,73]. Still, the impact in Reykjavík is relatively weak and limited to the immediate city center. In the city center, car ownership is disincentivized, e.g., through limited parking space supply, which has been suggested as an important issue in explaining car ownership [34,74,75] and was brought up by some of our interviewees as a key reason to live in a suburb. The city center also attracts people who seek urban liveliness and proximity in the residential environment [17]. Therefore, it is inhabited by a higher proportion of adult households without children, who are those most likely to live without a car, as also found in this study. Reykjavík is also sprawled, and the public transport system relies only on buses, not everywhere available frequently or with diverse routes. Therefore the visible built environment impact is limited to the immediate city center. However, it can also be interpreted as a built environment impact that the residents are highly motorized outside the city center. Therefore, what we observe as low built environment impact limited to the city center is also a strong impact all around, supporting, or even requiring car ownership. However, an interesting notion is that while several interviewees talked about residing in the city center due to it enabling car-free living, none of them had chosen a suburban location with good public transport access to live without a car, something suggested to be happening elsewhere [74,76,77]. This might be explained in three ways. Firstly, in Reykjavik, as a very affluent city, even the lower-income segments can usually afford to possess and operate a car. Secondly, the locations that offer the best bus access in the region might not reach the convenience level found in other cities. Third, car-culture in the city is still strong, cars carrying significant status symbol value, and the public transport system having a very low quality image. Therefore, even those not necessarily dependent on a car, typically possess (and operate) them.

One confounding factor in detecting patterns and causalities is that people tend to have already made changes in their car ownership statuses to prepare for major life-course changes [36,37]. For example, they might prepare to have a child by getting a car, moving to a suburb, or both. This effect could be a confounding factor in statistical analyses, as in the survey data, such households show as adult households living in the suburbs and

possessing a car. In contrast, both the residential location and car possession could be connected to the coming life phase change. As brought up above, our quantitative data show a much higher proportion of families with children in areas located farther away from the center and among households with at least one car. However, while families had a higher likelihood of having a car than childless couples in the regression model, the coefficients were not significant statistically, potentially partially due to this life course change preparation, as our qualitative interviews suggest. While having a child and car acquisition have been found to have a strong connection in many previous studies, the simultaneous movement away from the immediate city center has been discussed less frequently in the context of the built environment impact on car ownership.

To some extent, downtown dwellers' residential location choices are also related to travel modes other than cars. Public transport service-level was found to have some impact, although weak and statistically not significant in regression, many of our interviewees discussed it. Interestingly, all shared the same thought that those not using buses have the lowest opinion on the bus system's quality. Previous literature is mixed in this regard between the impact being rather connected to self-selection and other neighborhood qualities than the public transport service itself [74] and the service-level of public transport being an influential factor [26,77]. Residential self-selection was evident in our study, particularly in the interviews where the respondents brought up how their residential location choice was dominated by their preference to have a car at their disposal at any time or to be able to live without a car. Designated parking space was brought up as a reason to move to a suburb and the preference to anyway travel by car to all places as a reason not to worry about proximity to services. One respondent also explained how they have several cars and how they could never live in the city center with them, but do not want to reduce ownership, and another explained how the residential location was irrelevant for them and they could choose the place based on the apartment itself, and the price, as they anyway drive everywhere. Out of two factors of residential preferences analyzed in the article, only the suburban preference strongly correlated with the distance to the city center and clustered geographically. It suggests that other aspects than just a preference for certain travel modes, such as seeking quietness, are a predominant reason to reside in the suburbs. Low values of pro-car attitudes weakly cluster in the city center, which suggests they motivate some people to live close to downtown to move around by walking or cycling and live without a car—the reasons brought up by some interviewees.

5.2. Limitations

The study's main limitations and weaknesses arise from scope choices, data shortcomings, and the studied location's specialty. In this study, we only focused on looking at car ownership with an underlying thought that car-free would improve environmental (GHG) terms. However, while cars and their use cause high emissions, even higher emissions can be caused by the same money if not possessing a vehicle (or several). These "rebounds" for car ownership can be more than 100%, particularly if the money is used for leisure flights [78]. While this issue was outside the scope of this paper, several interviewees brought it up that it affects other consumption patterns that they have a car and need to spend money on it. Previous studies have also shown that the rebounds do not show across the income range [49,78]. Therefore, understanding at what levels of income and how the rebounds appear would be one prominent future research avenue.

The main data shortcoming is that due to the extremely high car ownership rate in Reykjavik, the number of survey respondents not possessing vehicles remained low (N = 78), hindering many potentially interesting statistical analyses. Future studies should then strive for much larger sample sizes, possibly with oversampling of the car-free population. Studying the car-free households in detail, their reasons, perceptions, etc., is also an interesting future research direction. Secondly, the cross-sectional nature of the data carries the well-known restrictions of such data. The combination of qualitative and quantitative data relaxes some of the restrictions, such as causality and self-selection

detection [12,13,19,48]. Still, a longitudinal perspective to the same respondents' travel preferences and perceptions, particularly after the BRT system's opening, would provide interesting additional opportunities. The qualitative component allowed us to observe some car ownership changes and the reasons behind them, as was shown in Section 3, due to the interviews taking place approximately two years after the survey and the interviewees talking about past events. Certain traveler types are more likely to change the mode than others [79,80], and studying these likelihoods and the determinants to them would be a prospective study direction.

5.3. Future Outlook for Reykjavik

Currently, the public transport usage rate is a very low 5% [55]. The city is currently building a bus rapid transit (BRT) system, Borgarlína, which is hoped to improve the number significantly. There is global evidence that this might happen [23,25], especially if the BRT system can make buses competitive with cars in travel times and provide service frequency similar to commuter trains [11,23]. Cervero [25] finds the BRT solution the most suitable for smaller cities. Based on a global comparison of 86 BRT systems, Ingvardson and Nielsen [24] reported bus ridership in specific corridors ranging from just a few percent up to 150%. Modal shift from cars was also found to be positive, although highly varying. The success of the forthcoming BRT system in Reykjavik, based on the literature, will rely on its relative time-competitiveness compared to cars [23]. According to Cervero [25], this can be achieved, for example, by dedicating lines only for the BRT buses: *"When buses operate on exclusive dedicated lanes, they tend to gain even more popularity by mimicking the speed advantages of metros, however, usually at a fraction of the construction cost."*

The other way round, allowing private cars to enter the (previously) dedicated BRT lanes may reduce the BRT impact on modal shift [81,82]. However, one must notice that BRT systems are not uniform but differ in, e.g., whether or not on completely segregated bus lanes, bus stop types, ticketing systems, service frequency, etc., and so far, no comprehensive evaluation exists on the influence on travel behavior of these issues [24]. Besides, Cao and Cao [74] suggest that most of the BRT impact might relate to self-selection. One additional aspect likely influential in the BRT system's success is improving public transport's public image in Reykjavík. The current image seems to be bad enough to hinder people from even trying public transport. Due to its plans related to the BRT system, Reykjavík provides an interesting case for a follow-up study later on.

Another aspect of the car-dominated travel and car-oriented culture in Reykjavik is that it is possible that the age segment of ours, adults aged 25 to 40, is not "young enough" to show changes in attitudes towards cars detected already elsewhere. Large-scale motorization took place relatively late in Reykjavik, as shown in Section 2.2. It may be the next generation who brings the change to Reykjavík. The interviews gave some weak indication about this, e.g., in I8, F38, describing how her stepson does not let his father get a car and believes that the younger generation getting a driver's license is not something automatic anymore.

Moreover, many interviewees said that even though the bus system's current image is very bad, it improves, particularly among the younger people. If accompanied by proper image-improvement measures, the BRT system's introduction might strongly impact the modal split and the VKT share of public transport.

An important location related motivation for car use in Reykjavik is the weather. While the city is similar to numerous relatively sprawled cities of the same size, it is undoubtedly rainy, windy, and cold compared to most of them, which many interviewees also brought up. However, Copenhagen and Amsterdam are among the global leaders in cycling rates [27] even though both experience relatively cold, rainy, and windy winters. Furthermore, due to the Gulf Stream, Reykjavík never experiences extreme temperatures similar to other locations at the same latitude, and summer and winter time averages are close to one another in global terms. Therefore, the weather should not stop Reykjavik from catching up with successful cycling and public transport cities worldwide.

Rather, Reykjavík is a city with a highly car-oriented urban structure developed through decades of car-centered planning, hindering the convenience of car-free lifestyles, and thus helping to perpetuate the car-oriented culture and associated social norms and discourses. The norms further hinder the car-free lifestyles and public transportation use by portraying them as strange and appropriate only for marginalized groups in society. Even though traces of a developing carless and urban lifestyle preference were found, particularly among downtown dwellers, some of its representatives finally fell for car ownership associated with childbearing. According to Klinger et al. [7], urban mobility cultures show considerable inertia and path dependencies and are unlikely to change in a short time. Nevertheless, urban planning in the region should strive to break the "vicious cycle" of car dependence and lifestyle lock-in by densifying the urban structure, particularly close to the city center; developing the BRT system together with locating new housing in transit corridors; improving the quality and image of the bus system; promoting and supporting car-free lifestyles; developing cycling infrastructure; and limiting the provision of new infrastructure for car traffic.

Such development could not only result in reducing mobility-related GHG emissions but also have a positive impact on equity. Despite Reykjavík being a globally affluent location, some residents (e.g., renters, immigrants, single parents) might still be at risk of poverty. Reducing car dependency might alleviate some of this risk among vulnerable groups.

Moreover, the currently prevailing TOD requires disincentives for car ownership and use to truly boost change. These disincentives could be, e.g., reducing the space available for cars within the existing infrastructure, such as devoting existing lines to buses, setting lower speed limits, significantly reducing parking space to make space for bicycle lanes, and increasing parking costs. On the other side, the current bus system is not just perceived as bad, but also as very expensive. The system's competitiveness should also be improved by reducing the cost or partially funding the system through car owners' payments. Such payments could be, e.g., mandatory public transport cards required for car owners, making the relative cost of private driving high compared to taking a bus.

6. Conclusions

The study presented in this paper is of importance to the academic community and the planners and decision-makers in Reykjavík. The academic value consists of several aspects of this study. First, as a case study of a location with very high affluence, very high car ownership level, and highly car-oriented mobility culture supported with car-oriented urban development across decades, but with a recent turnaround towards TOD, the findings provide a reference for future studies in Reykjavik and in similar settings elsewhere. Of particular interest are the findings related to the low built environment impact in such a context, and the justifications for car ownership provided by the interviewees, which indicate strong residential self-selection and deeply rooted social norm status of cars, up to the point that not having a car is stigmatized. Society pushes one to have a car to "live a decent quality life", and using buses puts one in a lower status category in society. These insights provide valuable material for understanding how to effectively support the transport system's transformation away from private car-dependency. Moreover, they also indicate that self-selection might be a stronger phenomenon than what typically appears in purely quantitative studies, in which several confounding factors might hinder it from showing. Second, our results on how the very low public transport usage level is strongly connected to the system's quality image and much less to the actual service-level are valuable information to academics studying transport systems and TOD as well as planners and decision-makers in Reykjavík. Third, with the BRT system soon starting operation, this study provides a valuable "before" status overview for future studies in the same location. Finally, the data utilized in this study were collected in 2017–2020, the collection period ending right before the COVID-19 pandemic. It, therefore, provides a perfect point of comparison for studies during and after the pandemic.

Supplementary Materials: The following are available online at https://www.mdpi.com/2071-1050/13/2/619/s1, Figure S1: Car ownership rates in Reykjavik postal codes, Figure S2: Hot spot and cold spot analysis of the factor scores of the "pro-environmental attitude" factor, Figure S3: Hot spot and cold spot analysis of the factor scores of the "suburban preference" factor, Figure S4: Hot spot and cold spot analysis of the factor scores of the "pro-car attitude" factor, Table S1: Rotated factor loadings retained in four-factor solution on answers to questions about preferences and attitudes related to the natural environment and leisure travel, Table S2: Rotated factor loadings retained in four-factor solution on answers to questions about residential preferences and urban mobility.

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References

1. IPCC 2018. Special Report on Global Warming of 1.5 °C (SR15). Available online: http://www.ipcc.ch/report/sr15/ (accessed on 2 November 2018).
2. Ewing, R.; Bartholomew, K.; Winkelman, S.; Walters, J.; Don Chen, D. *Growing Cooler: The Evidence on Urban Development and Climate Change*; Urban Land Institute: Washington, DC, USA, 2008.
3. Cervero, R.; Murakami, J. Effects of built environment on vehicle miles traveled: Evidence from 370 US urbanized areas. *Environ. Plann. A* **2010**, *42*, 400–418. [CrossRef]
4. Dillman, K.; Czepkiewicz, M.; Heinonen, J.; Fazeli, R.; Árnadóttir, Á.; Davíðsdóttir, B.; Shafiei, E. Decarbonization Scenarios for Reykjavik's passenger transport: The combined effects of behavioural changes and technological developments. *Sustain. Cities Soc.* **2020**, 102614. [CrossRef]
5. Næss, P. Built environment, causality and urban planning. *Plan. Theory Pr.* **2016**, *17*, 52–71. [CrossRef]
6. Mattioli, G.; Roberts, C.; Steinberger, J.; Brown, A. The political economy of car dependence: A systems of provision approach. *Energy Res. Soc. Sci.* **2020**, *66*, 101486. [CrossRef]
7. Klinger, T.; Kenworthy, J.; Lanzendorf, M. Dimensions of urban mobility cultures—A comparison of German cities. *J. Transp. Geogr.* **2013**, *31*, 18–29. [CrossRef]
8. Anowar, S.; Eluru, N.; Miranda-Moreno, L. Alternative Modeling Approaches Used for Examining Automobile Ownership: A Comprehensive Review. *Transp. Rev.* **2014**, *34*, 441–473. [CrossRef]
9. Ewing, R.; Cervero, R. Travel and the Built Environment. *A Meta-Analysis. J. Am. Plan. Assoc.* **2010**, *76*, 265–294. [CrossRef]
10. Newman, P.; Kenworthy, J. *Cities and Automobile Dependence: An International Sourcebook*; Gower Publishing: Brookfield, VT, USA, 1989.
11. Newman, P.; Kenworthy, J.; Glazebrook, G. Peak Car Use and the Rise of Global Rail: Why This Is Happening and What It Means for Large and Small Cites. *J. Transp. Technol.* **2013**, *3*, 272–287. [CrossRef]
12. Cao, X.; Næss, P.; Wolday, F. Examining the effects of the built environment on auto ownership in two Norwegian urban regions. *Transp. Res. Part D Transp. Environ.* **2019**, *67*, 464–474. [CrossRef]
13. Næss, P. Built environment, causality and travel. *Transp. Rev.* **2015**, *35*, 275–291. [CrossRef]
14. Newman, P.; Kosonen, L.; Kenworthy, J. Theory of urban fabrics: Planning the walking, transit/public transport and automobile/motor car cities for reduced car dependency. *Town Plan. Rev.* **2016**, *87*, 429–458. [CrossRef]
15. Schäfer, A. Regularities in Travel Demand: An International Perspective. *J. Transp. Stat.* **2000**, *3*, 1–31.
16. Ding, C.; Wang, Y.; Tang, T.; Mishra, S.; Liu, C. Joint analysis of the spatial impacts of built environment on car ownership and travel mode choice. *Transp. Res. Part D* **2018**, *60*, 28–40. [CrossRef]
17. Bhat, C.; Guo, J. A comprehensive analysis of built environment characteristics on household residential choice and auto ownership levels. *Transp. Res. Part B Methodol.* **2007**, *41*, 506–526. [CrossRef]
18. Mokhtarian, P.; Cao, X. Examining the impacts of residential self-selection on travel behavior: A focus on methodologies. *Transp. Res. Part B Methodol.* **2008**, *42*, 204–228. [CrossRef]

19. Macfarlane, G.; Garrow, L.; Mokhtarian, P. The influences of past and present residential locations on vehicle ownership decisions. *Transp. Res. Part Part A* **2015**, *74*, 186–200. [CrossRef]
20. McIntosh, J.; Trubka, R.; Kenworthy, J.; Newman, P. The role of urban form and transit in city car dependence: Analysis of 26 global cities from 1960 to 2000. *Transp. Res. Part D* **2014**, *33*, 95–110. [CrossRef]
21. Kenworthy, J. Reducing Passenger Transport Energy Use in Cities: A Comparative Perspective on Private and Public Transport Energy Use in American, Canadian, Australian, European and Asian Cities. *Urban Energy Transit.* **2018**, 169–204. [CrossRef]
22. Nolan, A. A dynamic analysis of household car ownership. *Transp. Res. Part A Policy Pr.* **2010**, *44*, 446–455. [CrossRef]
23. Bradley, M.; Kenworthy, J. Congestion Offsets: Transforming Cities by Letting Buses Compete. *World Transp. Policy Pract.* **2012**, *18*, 46–70.
24. Ingvardson, J.; Nielsen, O. Effects of new bus and rail rapid transit systems–an international review. *Transp. Rev.* **2018**, *38*, 96–116. [CrossRef]
25. Cervero, R. *Transport Infrastructure and the Environment: Sustainable Mobility and Urbanism, Working Paper, No. 2013-03*; Institute of Urban and Regional Development (IURD), University of California: Berkeley, CA, USA, 2013.
26. Zegras, C. The Built Environment and Motor Vehicle Ownership and Use: Evidence from Santiago de Chile. *Urban Stud.* **2010**, *47*, 1793–1817. [CrossRef]
27. Gössling, S. Urban transport transitions: Copenhagen, City of Cyclists. *J. Transp. Geogr.* **2013**, *33*, 196–206. [CrossRef]
28. Sick Nielsen, T.; Olafsson, A.; Carstensen, T.; Skov-Petersen, H. Environmental correlates of cycling: Evaluating urban form and location effects based on Danish micro-data. *Transp. Res. Part D Transp. Environ.* **2013**, *22*, 40–44. [CrossRef]
29. Zhou, F.; Zheng, Z.; Whitehead, J.; Perrons, R.; Washington, S.; Page, L. Examining the impact of car-sharing on private vehicle ownership. *Transp. Res. Part A Policy Pract.* **2020**, *138*, 322–341. [CrossRef]
30. Zailania, S.; Iranmanesh, M.; Masronc, T.; Chan, T. Is the intention to use public transport for different travel purposes determined by different factors? *Transp. Res. Part D Transp. Environ* **2016**, *49*, 18–24. [CrossRef]
31. Stopher, P. Voluntary Travel Behavior Change. *Handb. Transp. Strategy* **2005**, *6*, 561–579.
32. Lai, W.; Chen, C. Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement. *Transp. Policy* **2011**, *18*, 318–325. [CrossRef]
33. Guerra, E. The geography of car ownership in Mexico City: A joint model of households' residential location and car ownership decisions. *J. Transp. Geogr.* **2015**, *43*, 171–180. [CrossRef]
34. Jiang, Y.; Gu, P.; Chen, Y.; He, D.; Mao, Q. Influence of land use and street characteristics on car ownership and use: Evidence from Jinan, China. *Transp. Res. Part D* **2017**, *52*, 518–534. [CrossRef]
35. Guo, Z. Does residential parking supply affect household car ownership? The case of New York City. *J. Transp. Geogr.* **2013**, *26*, 18–28. [CrossRef]
36. Clark, B.; Lyons, G.; Chatterjee, K. Understanding the process that gives rise to household car ownership level changes. *J. Transp. Geogr.* **2016**, *55*, 110–120. [CrossRef]
37. Oakil, A.; Ettema, D.; Arentze, T.; Timmermans, H. Changing household car ownership level and life cycle events: An action in anticipation or an action on occurrence. *Transportation* **2014**, *41*, 889–904. [CrossRef]
38. Rice, J.L.; Cohen, D.A.; Long, J.; Jurjevich, J.R. Contradictions of the Climate-Friendly City: New Perspectives on Eco-Gentrification and Housing Justice. *Int. J. Urban Reg. Res.* **2019**, *44*, 145–165. [CrossRef]
39. Boucher, J. Cars, Culture, Carbon, and Climate: An Examination of the More and Less Visible Attributes of the Automobile. In *Sustainable Consumption, Promise or Myth? Case Studies from the Field*; Boucher, J., Heinonen, J., Eds.; Cambridge Scholars Publishing: Newcastle upon Tyne, UK, 2019.
40. Graham-Rowe, E.; Gardner, B.; Abraham, C.; Skippon, S.; Dittmar, H.; Hutchins, R.; Stannard, J. Mainstream Consumers Driving Plug-in Battery-Electric and Plug-in Hybrid Electric Cars: A Qualitative Analysis of Responses and Evaluations. *Transp. Res. Part A Policy Pr.* **2012**, *46*, 140–153. [CrossRef]
41. Steg, L. Car Use: Lust and Must. Instrumental, Symbolic and Affective Motives for Car Use. *Transp. Res. Part A Policy Pr.* **2005**, *39*, 147–162. [CrossRef]
42. Urry, J. The 'System' of Automobility. *Theory Cult. Soc.* **2004**, *21*, 25–39. [CrossRef]
43. Nieuwenhuis, P. Towards Sustainable Consumption of Automobility. In *Sustainable Consumption, Promise or Myth? Case Studies from the Field*; Boucher, J., Heinonen, J., Eds.; Cambridge Scholars Publishing: Newcastle upon Tyne, UK, 2019.
44. Sheller, M. Automotive Emotions: Feeling the Car. *Theory Cult. Soc.* **2004**, *21*, 221–242. [CrossRef]
45. Czepkiewicz, M.; Árnadóttir, Á.; Heinonen, J. Flights Dominate Travel Emissions of Young Urbanites. *Sustainability* **2019**, *11*, 6340. [CrossRef]
46. Reykjavík City 2014. Reykjavík Municipal Plan 2010–2030. Available online: http://adalskipulag.is (accessed on 20 January 2020).
47. Müggenburg, M.; Busch-Geertsema, A.; Lanzendorf, M. A review of the achievements and challenges of the mobility biographies approach and a framework for further research. *J. Transp. Geogr.* **2015**, *46*, 151–163. [CrossRef]
48. Næss, P. Validating explanatory qualitative research: Enhancing the interpretation of interviews in urban planning and transportation research. *Appl. Mobil.* **2018**, 1–20. [CrossRef]
49. Czepkiewicz, M.; Heinonen, J.; Næss, P.; Stefansdóttir, H. Who travels more, and why? A mixed-method study of urban dwellers' leisure travel. *Travel Behav. Soc.* **2020**, *19*, 67–81. [CrossRef]

50. Newman, P.; Kenworthy, J. 'Peak car use': Understanding the demise of automobile dependence. *World Transp. Policy Pract.* **2011**, *17*, 31–42.
51. Kenworthy, J. Is Automobile Dependence in Emerging Cities an Irresistible Force? Perspectives from São Paulo, Taipei, Prague, Mumbai, Shanghai, Beijing, and Guangzhou. *Sustainability* **2017**, *9*, 1953. [CrossRef]
52. Davis, B.; Dutzik, T.; Baxandall, P. *Transportation and the New Generation: Why Young People Are Driving Less and What It Means for Transportation Policy*; Frontier Group and US PIRG Education Fund: Washington, DC, USA, 2012.
53. Brown, H.; Vergragt, P. From consumerism to wellbeing: Toward a cultural transition? *J. Clean. Prod.* **2016**, *132*, 308–317. [CrossRef]
54. Schwanen, T. The Bumpy Road toward Low-Energy Urban Mobility: Case Studies from Two UK Cities. *Sustainability* **2015**, *7*, 7086–7111. [CrossRef]
55. Gallup Iceland. Samgöngu- og sveitarstjórnarráðuneytið, Samtök sveitarfélaga á höfuðborgarsvæðinu, Vegagerðin, Samgöngustofa og Isavia—Ferðir íbúa höfuðborgarsvæðisins, Október-Nóvember 2019; pp. 15–110. Available online: https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/SAM/02_H%c3%b6fu%c3%b0borgarsv%c3%a6%c3%b0i%c3%b0.pdf (accessed on 30 October 2020).
56. Valsson, T. *Planning in Iceland: From Settlement to Present Times*; University of Iceland Press: Reykjavík, Iceland, 2003; p. 480.
57. Reynarsson, B. *Borgir og Borgarskipulag–Þróun borga á Vesturlöndum Kaupmannahöf og Reykjavík (e. Cities and Urban Planning–Urban Development in the West, Copenhagen and Reykjavík*; Skrudda ehf.: Reykjavík, Iceland, 2014; p. 303.
58. Czepkiewicz, M.; Heinonen, J.; Árnadóttir, Á. The Quest for Sustainable Reykjavik Capital Region: Lifestyles, Attitudes, Transport Habits, Well-Being and Climate Impact of Young Adults (SuReCaRe); Report for a project funded by Skipulagstofnun Rannsóknar-og þróunarsjóður. 2018. Available online: http://www.skipulag.is/media/pdf-skjol/SuReCaRe.pdf (accessed on 4 December 2020).
59. Borgarlínan Project Office 2020. The Future of Public Transport. Available online: https://borgarlinan.is/ (accessed on 1 December 2020).
60. Pánek, J.; Benediktsson, K. Emotional mapping and its participatory potential: Opinions about cycling conditions in Reykjavík, Iceland. *Cities* **2017**, *61*, 65–73. [CrossRef]
61. Sigurðsson, H. Adalskipulag Reykjavikur 2010-2030 í sögulegu ljósi. In *Reykjavík á Tímamótum*; Reynarsson, B., Ed.; Skrudda ehf.: Reykjavík, Iceland, 2017; p. 239.
62. Hermannsson, Þ. Höfudborgarsvædid—Þróun samgöngustefnu. In *Reykjavík á Tímamótum*; Reynarsson, B., Ed.; Skrudda ehf.: Reykjavík, Iceland, 2017; p. 239.
63. Reykjavík City 2020. Reykjavík í Tölum. Available online: http://tolur.reykjavik.is/ (accessed on 14 May 2020).
64. Eurostat 2020. Passenger Cars in the EU. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_cars_in_the_EU#Highest_number_of_passenger_cars_per_inhabitant_in_Luxembourg (accessed on 15 April 2020).
65. Maciag, M. Vehicle Ownership in US Cities Data and Map—Statistics on Car-Free Households and Numbers of Vehicles Per Household for Cities. 2017. Available online: https://www.governing.com/gov-data/car-ownership-numbers-of-vehicles-by-city-map.html (accessed on 26 May 2020).
66. Collin-Lange, V. My Car is the Best Thing That Ever Happened to Me: Automobility and Novice Drivers in Iceland. *Young* **2014**, *22*, 185–201. [CrossRef]
67. Collin-Lange, V.; Benediktsson, K. Entering the regime of automobility: Car ownership and use by novice drivers in Iceland. *J. Transp. Geogr.* **2011**, *19*, 851–858. [CrossRef]
68. Czepkiewicz, M.; Jankowski, P.; Zwoliński, Z. Geo-questionnaire: A spatially explicit method for eliciting public preferences, behavioural patterns, and local knowledge–An overview. *Quaest. Geogr.* **2018**, *37*, 177–190. [CrossRef]
69. Czepkiewicz, M.; Jankowski, P.; & Młodkowski, M. Geo-questionnaires in urban planning: Recruitment methods, participant engagement, and data quality. *Cartogr. Geogr. Inf. Sci.* **2016**, *44*, 551–567. [CrossRef]
70. Söderström, P.; Schulman, H.; Ristimäki, M. Urban Form Helsinki Stockholm City Regions: Development Pedestrian, Public Transport and Car Zones. In *Reports of the Finnish Environment Institute*; Finnish Environment Institute: Helsinki, Finland, 2015; p. 16.
71. Tjur, T. Coefficients of determination in logistic regression models—A new proposal: The coefficient of discrimination. *Am. Stat.* **2009**, *63*, 366–372. [CrossRef]
72. Matas, A.; Raymond, J.; Roig, J. Car ownership and access to jobs in Spain. *SSRN Electron. J.* **2008**, *43*, 607–617. [CrossRef]
73. Glaeser, E.; Kahn, M. The greenness of cities: Carbon dioxide emissions and urban development. *J. Urban Econ.* **2010**, *67*, 404–418. [CrossRef]
74. Cao, J.; Cao, X. The Impacts of LRT, Neighbourhood Characteristics, and Self-selection on Auto Ownership: Evidence from Minneapolis—St. Paul. *Urban Stud.* **2014**, *51*, 2068–2087. [CrossRef]
75. Chatman, D.G. Does TOD need the T? On the importance of factors other than rail access. *J. Am. Plan. Assoc.* **2013**, *79*, 17–31. [CrossRef]
76. Glaeser, E.; Kahn, M.; Rappaport, J. Why do the poor live in cities? The role of public transportation. *J. Urban Econ.* **2008**, *63*, 1–24. [CrossRef]
77. Gascon, M.; Marquet, O.; Gràcia-Lavedan, E.; Ambròs, A.; Götschi, T.; de Nazelle, A.; Panis, L.; Gerike, R.; Brand, C.; Dons, E.; et al. What explains public transport use? Evidence from seven European cities. *Transp. Policy* **2020**, *99*, 362–374. [CrossRef]

78. Ottelin, J.; Heinonen, J.; Junnila, S. Rebound Effects for Reduced Car Ownership and Driving. In *Nordic Experiences of Sustainable Planning: Policy and Practice*; Kristjánsdóttir, S., Ed.; Routledge: Oxfordshire, UK, 2017.
79. Vij, A.; Carrel, A.; Walker, J. Incorporating the influence of latent modal preferences on travel mode choice behavior. *Transp. Res. Part A: Policy Pr.* **2013**, *54*, 164–178. [CrossRef]
80. Keskisaari, V.; Ottelin, J.; Heinonen, J. Greenhouse gas impacts of different modality style classes using latent class travel behavior model. *J. Transp. Geogr.* **2017**, *65*, 155–164. [CrossRef]
81. Mane, A.; Bhaskar, A.; Sarkar, A.; Arkatkar, S. Effect of bus-lane usage by private vehicles on modal shift. *Proc. Inst. Civ. Eng.* **2018**, *171*, 85–97. [CrossRef]
82. Clark, S.; Rey, S. Temporal dynamics in local vehicle ownership for Great Britain. *J. Transp. Geogr.* **2017**, *62*, 30–37. [CrossRef]