The quest for sustainable Reykjavik Capital Region 2: mobility styles, residential location, and life satisfaction of young adults (SuReCaRe 2)

Sjálfbær þróun á Höfuðborgarsvæðinu 2: ferðamátar, búsetustaðsetning og lífsviðhorf ungs fólks

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Executive summary

The SuReCaRe 2 project investigates interrelationships between urban form at a residential location, mobility styles, and travel patterns of young adults in Reykjavik Capital Region, and their association with two sustainability outcomes: satisfaction with life domains and greenhouse gas (GHG) emissions. The project utilizes a quantitative data set collected in 2017 with softGIS method (Kahila and Kyttä, 2009; Czepkiewicz et al., 2018c), containing 780 responses, expanded with qualitative interviews.

Project targets

The project was set to address three research goals:

1. To identify distinct mobility styles among Reykjavik young adults based on their travel patterns, residential location, and related preferences
2. To investigate relationships between the mobility styles, and two facets of urban sustainability: subjective well-being, and greenhouse gas (GHG) emissions
3. To explain causal mechanisms and elicit personal rationales behind observed associations between mobility styles, residential choices, urban form, and well-being.

In explaining the causal mechanisms, particularly four themes were set as the focus areas:

> **Theme 1.** Rationales behind residential choices among Reykjavik young adults, with a particular focus on urban density, accessibility, and transportation network
> **Theme 2.** Relationships between urban form and other environmental characteristics (e.g. urban density, service accessibility, transportation network) and subjective well-being
> **Theme 3.** Relationships between daily travel patterns (e.g. use of travel modes, commuting distances) and subjective well-being
> **Theme 4.** Relationships between urban form and other environmental characteristics (e.g. urban density, access to green and open spaces) and long-distance travel patterns (e.g. international flights, within-country weekend trips).

Materials and methods

The study utilizes a mixed-method approach with both quantitative and qualitative data. The main quantitative data set was collected among the adults aged 25 to 40 living in the Reykjavik Capital Region in 2017 with softGIS method. The survey contains 780 responses. The qualitative data was collected in 2018-2019 with in-depth interviews with the selected survey respondents.

Results

Modality styles

Six modality style groups were found based on the dominant travel behavior features:

1) *Consistent car commuters (36%)*
2) *Multi-modal car commuters (21%)*
3) *Non-commuters (14%)*
4) *Pedestrian commuters (13%)*
5) *Bus commuters (8%)*
6) *Bicycle commuters (8%)*

Compared to other groups, the *consistent car commuters* are somewhat more likely to be employed full time and have on average slightly higher incomes. They are more likely to live far away from the city center (7.34 km, on average), in car-oriented urban zones with poor access to public transportation.

The *multi-modal car commuters* are also likely to be employed full-time. They tend to have a graduate-level education and be in a household with a child or children. Both car-commuting groups have a higher percentage of Icelandic speaking people than the whole sample. They live relatively far from the city center (6.27 km, which is close to the sample average) and often in the car-oriented urban zone. Compared to other groups, they are more likely to live close to the sub-centers (14% compared to 7% in the whole sample), which suggests that their use of walking for non-commuting trips is influenced by proximity to services.

Non-commuters have a high percentage of women. Even though 52% of them report being fully employed, they are also likely to be stay-at-home parents, unemployed, or unable to work. On average, this group has lower incomes and education levels than other groups, and have a higher percentage of non-Icelandic speaking people. They live relatively far away from the city center (6.49 km) and are somewhat more likely to live in places with decent access to public transportation than members of the other groups.

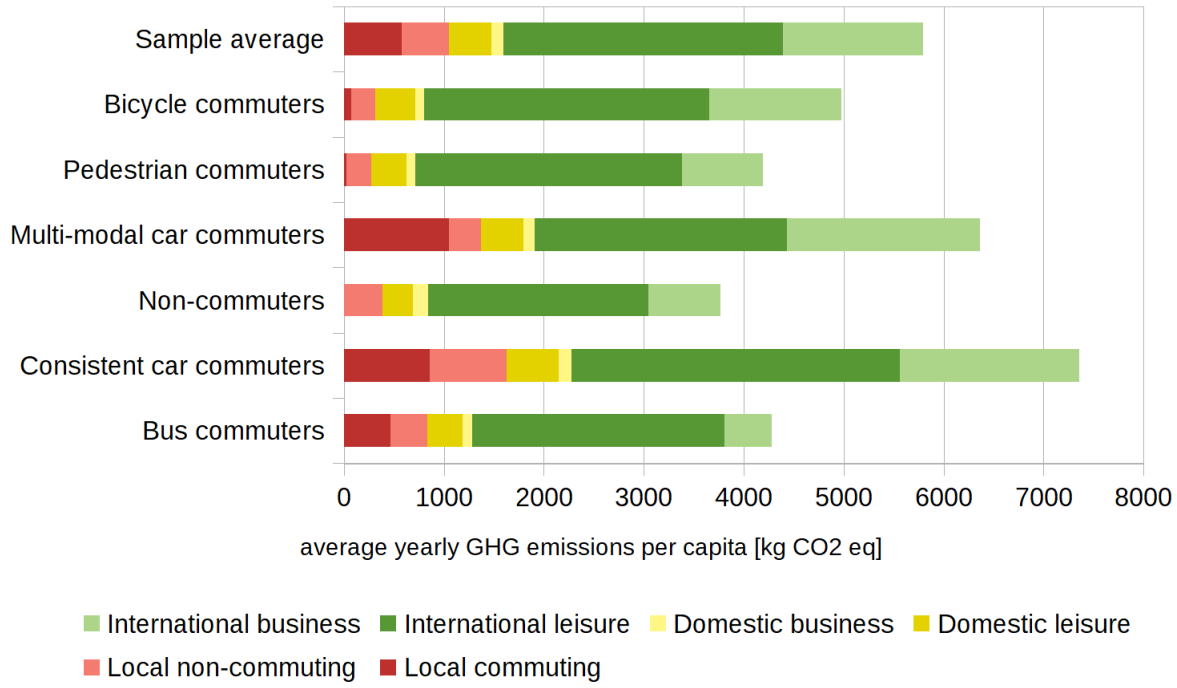
The *pedestrian commuters* are more likely than other groups to be employed part-time, self-employed or entrepreneurs. Even if 40% of them are in households with children, the group has a relatively high percentage of childless couples and single households. They live relatively close to the city center, albeit this distance is often considerable (4.10 km, on average). They are more likely to live in the central pedestrian zone or its fringe (33% and 29%, respectively), but still, 25% of them lives in the car-oriented zone.

The *bus commuters* are predominantly men, have on average a lower level of education and lower incomes. They have a high percentage of single households and non-Icelandic speaking

people. They live on average 5.8 km from the city center. Compared to other groups, they are somewhat more likely to live in the central pedestrian zone and its fringe, and less likely to live in the car-oriented zone. Their residential location seems to be unaffected by access to public transportation or proximity to the sub-centers.

The *bicycle commuters* are somewhat more likely to be men, employed full-time or studying, with graduate or postgraduate education, single, and Icelandic speaking. They live relatively close to the city center (4.52 km) and are more likely than other groups to live in the fringe of the central pedestrian zones (33% compared to 22% in the whole sample).

The *consistent car commuters* are the most mobile both within the Reykjavik Capital Region and away from it. They have the highest total amount of emissions resulting from travel. They cover the longest distances in their local travel (i.e. within the urban region) among all the groups (over 7 thousand km per year). Together with a very high proportion of trips made by cars, it results with the yearly amount of emissions from local travel of 1.6 tons of CO2eq per capita (compared to the sample average of 0.9 tons). Furthermore, they made on average more domestic leisure trips in the previous year than the other groups (10.2 trips, compared to the sample average of 8.5), and had the highest average yearly GHG emissions from domestic leisure trips (0.64 tons of CO2eq per capita, compared to the sample average of half a ton). They also are the most frequent flyers with 2.34 international leisure trips per year, compared to the sample average of 2.02. The GHG emissions resulting from international trips of this group amount to 5.1 tons of CO2eq per capita, of which 3.3 tons results from trips unrelated to their work or studies.



Activity spaces in local travel

Preferences and attitudes

Psychological factors influence travel behaviors and shape mobility styles similarly as the urban form does. Eight factors with different influences were defined in the study:

1) *Pro-environmental attitude*
2) *Climate change awareness*
3) *A cosmopolitan attitude in travel*
4) *Preference for urban vs. natural settings in travel*
5) *Suburban preference*
6) *Pro-car attitude*
7) *Preference for shared housing and transport*
8) *Preference for nature and privacy.*

Six mobility style groups were defined with distinct attitudinal and travel behavior features and clustering in space:

Concerned pro-density urbanites	Compared to other groups, they have a relatively high environmental concern and willingness to live ecologically. They are somewhat more cosmopolitan in their travel interests and tend to prefer urban environments both in leisure travel destinations and in a residential location. They strongly dislike suburban residential environments and are rather positive towards sharing apartments with others and living close to their neighbors.
Pro-car suburbanites	Compared to other groups, they are somewhat more aware and concerned about climate change and are somewhat less cosmopolitan in their travel interests. They prefer natural environments as leisure travel destinations, as well as suburban and green residential locations. They have a positive attitude towards the car as a daily travel mode.
Unconcerned pro-car urbanites	Compared to other groups, they have lower concern for the environment, willingness to live ecologically, and climate change awareness and concern. They tend to prefer urban environments in leisure travel and dislike suburban residential environments. They have a strongly positive attitude towards the car as a travel mode.
Anti-car environmentalists	Compared to other groups, they have a very high level of environmental concern and willingness to live ecologically. They strongly dislike the car as a daily travel mode and instead opt for other travel modes.
Unconcerned suburbanites	Compared to other groups, they have lower environmental concern and willingness to live ecologically, as well as lower climate change awareness and concern. They also tend to be somewhat less cosmopolitan in their travel interests. They tend to prefer suburban residential environments.
Cosmopolitan urbanites	Compared to other groups, they are much more cosmopolitan in their travel interests, but also tend to prefer natural over urban environments in leisure travel. They tend to dislike suburban residential environments, but value access to natural environments close to home.

Attitudes vs. travel behaviors

Bus commuters tend to be more concerned than other groups about environmental impacts and more willing to live ecologically. They tend to prefer urban environments in leisure travel and dislike car as a daily travel mode.

Consistent car commuters tend to have somewhat weaker pro-environmental attitudes than other groups, even though they are aware of climate change. They have a strong preference for using cars in daily travel.

Multi-modal car commuters differ from *consistent car commuters* in that their preference for cars is average. In turn, they do not mind sharing their housing environments or trips with others, as much as the other groups do.

Non-commuters are more concerned than other groups about general environmental impacts but are somewhat less not in case of climate change. They rather do not seek novelty or diversity in their leisure travel (i.e. don't have cosmopolitan attitudes). They dislike sharing their housing or trips with others, in turn opting for residential environments that are suburban, secluded, and close to nature.

Pedestrian commuters dislike car as a daily travel mode and suburbs, but they like closeness to nature in residential environments, as well as on leisure trips. On average, they are not much in favor of sharing their housing environments or trips with others.

Bicycle commuters very strongly dislike cars as a daily travel mode. They tend to be concerned and aware of climate change and have a slightly stronger preference for urban rather than natural environments in leisure and residential context alike.

Mobility styles and subjective well-being

Clear differences were found between the mobility style groups on their stated subjective well-being. Car commuters (consistent and multi-modal) reported the highest levels of satisfaction, whereas bus commuters and non-commuters reported the lowest. This implies that bus commuting and non-commuting are fewer choices made by will, but more a life course situation (non-commuting) or due to the feeling of no other option being available or serving well (bus commuting). Those primarily commuting by foot were found to have the highest life satisfaction as a whole. Interestingly, those using cars reported the lowest satisfaction with the amount of time to do things they would like to do. Bicycle commuters were found to have the highest satisfaction with their state of health.

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1 Background and project goal

Cities and their structural characteristics have been connected to the issue of local and global sustainability, and the compact city has emerged as a planning ideal promoted as beneficial from a sustainability perspective (Holden & Norland, 2005). To a large extent, the effect of compact urban form on sustainability benefits has been supported by academic research, but numerous questions and contextual differences remain. However, it has also been questioned if the gains relate only to reduced private car use, and suggested that lifestyles become more consumption oriented in more compact settings leading to overall higher negative environmental impacts (Heinonen et al. 2013). In addition, differences in geographical contexts, social norms, and individual preferences call for further research and consideration in planning and decision-making. The SuReCaRe 2 project is based on existing evidence from Nordic and other countries in the following four themes.

Theme 1. Urban form and daily travel behavior

There is currently relatively well-established knowledge on the relationship between urban form and daily travel behavior. Multiple studies in the U.S. show that compact neighborhood characteristics such as density, diversity of land uses, and proximity of destinations, decrease car use (Ewing and Cervero, 2010). Research in the Nordic context further emphasizes the role of distance to the city center and local centers in decreasing car use and ownership (Næss 2012). However, the magnitude and character of relationships, particularly in relation to individual preferences and social norms, are still debated and new research questions arise (Næss 2014). The urban form appears to influence daily travel patterns, but the choice of travel modes and residential locations are also interconnected in the so-called residential self-selection issue (van Wee, 2009). The extent to which the residential location matches preferences (i.e. dissonance or consonance) is thus thought to influence daily travel patterns (Manaugh & El-Geneidy, 2015). Individual differences in preferences related to transportation and residential location (described as mobility styles, Ohnmacht et al, 2009; Prillwitz & Barr, 2011) and related differences between cities (described as urban mobility cultures, Klinger et al., 2013), are thus relevant factors in research on travel behaviors (e.g. van Wee and Boarnet, 2014), and land use and transportation planning, as they influence demand for travel modes and transportation infrastructure, and acceptance for policy measures. The influence on travel behavior of the environmental and cultural characteristics specific to Iceland and the Capital Region, such as high cultural and utilitarian importance of private cars (Colin-Lange & Benediktsson, 2011), relatively low density and high car-orientation of the urban structure (when compared to other Nordic cities), and issues with housing affordability, should be studied in more detail. There have been so far few studies on this topic in Iceland, and proposed research will contribute to international and national literature, and inform land use and transportation planning in the Capital Region.

Theme 2. Urban form and well-being.

In urban planning literature, the compact, walkable, and diverse neighborhoods have been promoted as beneficial for social and individual well-being of residents (e.g. Gehl, 2010;

Montgomery, 2013). There is some empirical support for their positive influence on social well-being (Kyttä et al., 2016; Mouratidis, 2017), and physical activity (Sallis et al., 2016), but the results are mixed and most likely context-specific (Talen and Koschinsky, 2013). Despite the benefits of accessibility and social proximity, preferences for suburban residence are still prevalent and dense neighborhoods often disliked (e.g. Brookfield, 2016). The urban form may be further related to environmental stressors, such as noise or traffic, that influence health and well-being (Frumkin, 2002; Evans, 2003). Access to private and public green spaces contributes to psychological restoration and well-being (van den Berg et al., 2007; Groenewegen et al., 2012) and is an important part of residential preferences. Due to multiple constraints of the housing market, such as availability and price, residential sorting based on preferences is not complete, and dissonance between residential preferences and actual location may further impact satisfaction among residents. Such issues are highly contextual and cultural, and the associations vary between countries and cities (e.g. Mouratidis, 2017). This study on young adults of Reykjavik Capital Region will contribute to international research as well as inform land use planning and housing policy with current and future demand for various housing and neighborhood characteristics, the influence of built environment on well-being, attitudes towards compact developments, and sources of residential dissatisfaction among the population.

Theme 3. Daily travel behavior and wellbeing.

Long commutes from suburban neighborhoods are associated with less time spent at homes and residential areas, thus negatively influencing life satisfaction and relationships among families (Stutzer and Frey 2008) and local communities (Putnam 2000). Commuting negatively affects people's current mood (Kahneman et al. 2004), particularly by car or bus, while walking and cycling are associated with positive mood (Gaterslebem & Uzzell, 2007; Morris & Guerra, 2014) and health improvements (Pucher et al., 2010, de Hartog et al. 2010). However, the effects of daily mobility on well-being are likely modified by personal preferences or mobility styles. For instance, a positive or negative outlook on a specific travel mode may modify its positive or negative impacts on well-being. The dissonance between travel-related preferences and residential neighborhood may cause dissatisfaction, e.g. among people who would prefer walking to work, but their non-central and more affordable residence only allows car or bus commuting. Such interdependencies are relevant for residential choices, travel behaviors, and may potentially influence planning policies related to transportation, housing, and land use.

Theme 4. Urban form and long-distance travel behavior.

Research on associations between urban form and sustainable mobility usually focuses on daily travel (e.g. Ewing and Cervero, 2010; Næss, 2012). However, recent research suggests that reductions in emissions in daily travel are often associated with increases in emissions in other categories and that these increases often exceed the level of reductions, especially when indirect emissions are taken into account (Ottelin, 2016). Importantly, several studies have observed higher levels of long-distance travel and particularly air travel in big cities and densely built parts of urban regions (Holden & Norland, 2005; Brand & Preston 2010; Holz-Rau et al. 2014; Ottelin et al. 2014; Reichert et al. 2016; Czepkiewicz et al. 2018a). The results seemingly challenge planning policies related to compact urban form by suggesting that gains from densification may be offset by rebound effects (Holden & Linnerud, 2011). Researchers have suggested various explanations of this relationship including a rebound effect, in which lower level of car ownership and use allows for increased expenditures on

other goods and services, especially holiday travel (Heinonen et al. 2013a,b; Ottelin et al. 2017), compensation hypothesis, in which the residents of densely populated urban areas tend to compensate for the lack of open space, green areas, and recreational opportunities by taking longer and more distant holiday or weekend trips (Holden & Norland 2005; Strandell & Hall 2015), and cosmopolitan character of urban lifestyles (Næss 2006; Holden & Linnerud, 2011). There is currently a need for more research on these explanations, and the topic is central to the SuReCaRe project. The issue is most likely highly contextual, and evidence from the Capital Region, with relatively low density levels, high car ownership rate, and good access to open spaces may provide both good contribution to academic literature, and elucidate some of the factors behind relatively high consumption-based carbon footprint in Iceland (Clarke et al., 2017), relevant for sustainability management in the country.

Project goal

The SuReCaRe project is set to improve our understanding of the premises of creating sustainable urban settlements, with the focus on Reykjavik Capital Region. The project approaches the issue in a novel way never used in Iceland before. Data about lifestyles travel behaviors and attitudes were collected with a *softGIS* survey combining an interactive map and conventional survey questions and complemented with in-depth interviews. Climate impact of individual behavior is estimated using a life-cycle analysis (LCA) methodology that takes into account indirect sources of greenhouse gas emissions. The combination of methods enables new analytical possibilities that will improve understanding of individual lifestyles and premises of sustainable urban development of the Capital Region.

The project was set to address the following research goals:

1. To identify distinct mobility styles among Reykjavik young adults based on their travel patterns, residential location, and related preferences
2. To investigate relationships between the mobility styles, and two facets of urban sustainability: subjective well-being, and greenhouse gas (GHG) emissions
3. To explain causal mechanisms and elicit personal rationales behind observed associations between mobility styles, residential choices, urban form, and well-being. In particular, the project aims to use qualitative research methods to study four themes:
    a. **Theme 1.** Rationales behind residential choices among Reykjavik young adults, with a particular focus on urban density, accessibility, and transportation network,
    b. **Theme 2.** Relationships between urban form and other environmental characteristics (e.g. urban density, service accessibility, transportation network) and subjective well-being,
    c. **Theme 3.** Relationships between daily travel patterns (e.g. use of travel modes, commuting distances) and subjective well-being.
    d. **Theme 4.** Relationships between urban form and other environmental characteristics (e.g. urban density, access to green and open spaces) and long-distance travel patterns (e.g. international flights, within-country weekend trips).

2 Materials and methods

2.1 Quantitative data collection and sampling

The quantitative results are based on an online survey administered between 12th of September and 7th of November 2017 in three languages: Icelandic, English, and Polish. The survey employed a softGIS method, which combines traditional questionnaires with Internet maps and allows participants to mark locations on a map and answer questions pertaining to these locations (Brown and Kyttä, 2014; Czepkiewicz et al., 2018c). The questionnaire is available online at https://app.maptionnaire.com/en/2294/.

The target population of the survey consisted of all registered residents of the **Reykjavík Capital Region** (the municipalities of Reykjavík, Kópavogur, Hafnarfjörður, Garðabær, Mosfellsbær, Seltjarnarnes, and Kjósarhreppur), **aged between 25 and 40** as of 1st of August 2017. Sampling was done by randomly drawing **6000** target group members from Registers Iceland, (Þjóðskrá Íslands) using a geographically stratified sampling method, in which the proportion of residents of each municipality is the same in the sample as it is in the target population. About **5184** invitations have been properly delivered and resulted in **735** answers (response rate 14.2%), of which **588** were completed (response rate 11.3%).

2.2 Trip distances and frequencies

The calculation of distances differed between geographical scopes and travel modes:

1. Distances to international and domestic destinations visited by plane and international locations visited by ferries were calculated as geodesic shortest distances between home and the destination in a Spatialite database using The World Geodetic System 1984 (WGS84) coordinate system to take into account the curvature of the Earth. Every regional and international destination was treated as a two-way trip. The distance estimation was corrected by multiplying by 1.2 per interchange to account for the deviations from the shortest distances that result from the interchanges.
2. Distances to international destinations not originating in Iceland and visited by car, bus, or train, were calculated as geodesic shortest distances and multiplied by a "detour factor" of 1.417 to account for the deviations from the shortest distances that result from the street and rail network layouts.
3. Distances to domestic destinations visited by car, bus or ferry, were calculated along the road network data obtained from the i50v topographic map, and the ferry network data obtained from EuroGlobalMap and OpenStreetMap and checked with ferry operators' websites. The distances between home locations and destinations were then calculated using Route tool in the Network Analyst toolbox in ArcMap 10.
4. Distances to local destinations were calculated along the street network data obtained from OpenStreetMap for walking and cycling, and i50v topographic map for car and bus. The distances between home locations and destinations were then calculated using Route tool in the Network Analyst toolbox in ArcMap 10.

The frequencies of local trips were measured in categories related to weekly or monthly periods (e.g. "five to seven times a week" or "once or twice a month") and coded numerically to estimate the number of trips made during 12 months. The reported number of trips in regional and international travel was also coded numerically and used to estimate the number

of trips in 12 months. The yearly distance traveled to each of the marked destinations was then estimated by multiplying distances and frequencies. The yearly distances were then multiplied by GHG emission coefficients described below.

2.3 Greenhouse gas emissions calculation

The GHG assessment was conducted with a life cycle assessment (LCA) approach, which considers both the direct and indirect emissions from travel. Typically only the direct emissions, those from fuel combustion, are included in an assessment, which might lead to biased outcomes and policy-guidelines (Chester & Horvath 2009). The sources of indirect emissions include fuel and electricity production (for electric vehicles), vehicle manufacturing, and infrastructure construction, which are also major contributors to the GHG emissions from transport. The measures of global warming potential over 100 years (GWP100) was employed. In addition to the long-lived GHGs (LLGHG) typically included in GWP calculations, such as carbon dioxide or nitrous oxide, the short-lived climate forcers (SLCFs) were included, such as black carbon, organic carbon, volatile organic compounds, contrails, and aircraft-induced cirrus. The SLCFs are highly relevant for estimating the climate impacts of air travel and less relevant for those from ground transport (Aamaas et al., 2013).

Following emission data sources were utilized:

1. Due to the absence of data sources from Iceland, the direct combustion emissions of buses were taken from the LIPASTO database produced by the VTT Technical Research Centre of Finland Ltd (VTT 2016).
2. For air travel, the combustion phase emissions were taken from Aamaas et al. (2013), and the split into short (<800 km) and long (>800 km) flights follow the source. The values are considerably higher than values without SLCFs provided by VTT (2016), where emissions are estimated at 0.26 CO2e kg/PKT for flights shorter than 463 km, and at 0.11 CO2e kg/PKT for flights above 3000 km. Therefore, the inclusion of SLCFs emphasizes the importance of emissions caused by air travel, and long-haul flights in particular.
3. The indirect emissions coefficients were taken from Chester and Horvath (2009), including roadways, tracks, stations, runways, and other infrastructure, vehicle production and maintenance and fuel production. The uncertainty of the measures lies in the assumptions that the emissions are compatible between the U.S. and Iceland.
4. For trips with private cars, the fuel efficiencies and occupancy rates reported by the survey respondents were used. The fuel efficiency was asked with a five-category question with options from below 4 liters per 100 km (l/100km) up to over 10 l/100km with two-liter intervals and separate options for electric vehicles. For those who did not answer the question on fuel efficiency, the average if 7.6 l/100km was assumed. For the trips without data on car occupancy, the average occupancy rates of 1.3 for local trips and 1.9 for all other trips were assumed, following the LIPASTO database.
5. The estimated fuel consumption was turned into GHG emissions with a multiplier of 2.36 kg CO2e/liter (US EPA, 2008).

Table 1. GHG emission coefficients per travel mode in CO2e kilogram equivalents per person kilometer traveled [kg/PKT]

Travel scope	Travel mode	Explanation and sources	Direct emissions: combustion	Indirect emissions: Fuel production	Indirect emissions: Life-cycle	Total emissions
Local	Car	Reported fuel efficiency (liters per km, survey data) times 2.36 kg CO2e/liter (US EPA, 2008), divided by 1.3 car occupancy (VTT, 2016). Indirect emissions for San Francisco Muni (Chester & Horvath, 2009).	0.138 (average)	0.026	0.074	0.238
	Bus	Natural gas bus, the average occupancy rate in local traffic, 18/50 passengers (VTT, 2016).	0.069	0.031	0.050	0.150
Domestic and international	Plane <800 km	LLGHGs and SLCFs included (Aamaas et al., 2013), indirect emissions for a midsize aircraft (Chester & Horvath, 2009).	0.300	Included in combustion factor	0.020	0.320
	Plane >800 km		0.240	Included in combustion factor	0.020	0.260
	Ferry	Helsinki- Stockholm, average occupancy (VTT, 2016), indirect emissions for a midsize aircraft (Chester & Horvath, 2009).	0.223	0.015	0.020	0.258
	Bus	Diesel bus, average occupancy rate on long distance trips, 12/50 passengers (VTT, 2016)	0.049	0.037	0.058	0.144
	Train	Pendolino and intercity trains, average occupancy (VTT, 2016). Indirect emissions for an SFBA Caltrain (Chester & Horvath, 2009).	0.022	Included in combustion factor	0.062	0.084

2.4 Travel-related Urban Zones

Some of the results in the report are presented in relation to the travel-related urban zones (Figure 1). The classification of the Reykjavik Capital Region into these zones was conducted in the first part of the SuReCaRe project funded by the Skipulagsstofnun. The classification method was based on the theory of three urban fabrics: a walking city, a transit city, a and car city, proposed by Newman et al. (2016) and followed a similar classification performed in Helsinki and Stockholm and described by Ristimäki et al. (2011) and Söderström et al. (2015). The definitions and calculations used in developing the urban zones for the Capital Region are presented in the table below.

Table 2. The criteria used to delineate the travel-related urban zones

Zone name	Definition	GIS calculations
The central pedestrian zone	Densely built and populated, located within a walkable distance from the main commercial center (up to 1500 meters), contains a high number and diversity of jobs and services, and has good access to public transport.	Assigned to the cells within the contiguous area within 1500 m network distance from the main commercial center.
The fringe of the central pedestrian zone	Densely built and populated, located within a bikeable distance from the main commercial center (up to 3000 meters) from the main commercial center, contains a high number and diversity of jobs and services, and has good access to public transport.	Assigned to the cells within the contiguous area between 1500 and 3000 m distance from the main commercial center.
Intensive public transportation zone	The area in which the public transport frequency is at least 10 departures per hour and walking distance to a bus stop is less than 5 minutes (332 meters)	Assigned to the cells not included in the above zones and having a bus stop with at least 10 departures per hour within a 5-minute walk (332 m street network distance).
Basic public transportation zone	The area in which the public transport frequency is at least 4 departures per hour and walking distance to a bus stop is less than 5 minutes (332 meters)	Assigned to the cells not included in the above zones and having a bus stop with at least 4 departures per hour within walk (332 m street network distance).
Car-oriented zone	The area in which the public transport frequency is less than 4 departures per hour or there is no bus stop within walking distance of 5 minutes (332 meters)	Assigned to the remaining cells, not included in the above zones.

In the methods applied in Helsinki and Stockholm pedestrian zones of sub-centers were delineated as one of the zones. Besides being concentrations of population and retail jobs, and major public transportation hubs, these areas are characterized by having a mix of functions and land uses, and a walkable urban structure (Ristimäki et al., 2011). Seven commercial sub-centers were identified in the region (Figure 1). Even though none of them is surrounded by a pedestrian-friendly zone, we retained them in the classification used in this report to highlight the importance of the access to the sub-centers for the travel patterns within the region.

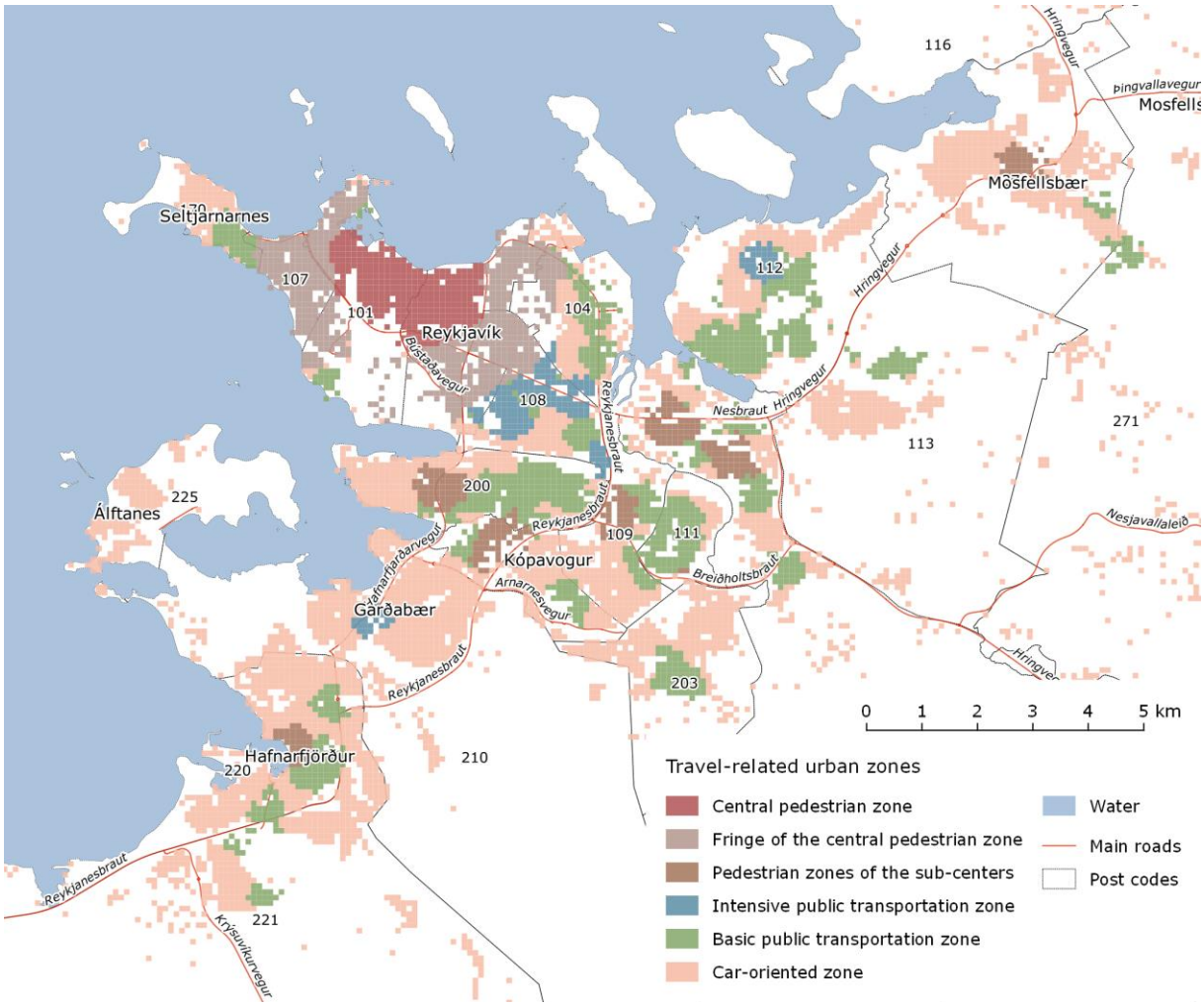

Figure 1. Travel-related urban zones of the Reykjavik Capital Region.

2.5 Activity Spaces

Activity space is a concept used to describe the spatial behavior of individuals using geometric and thematic characteristic (Perchoux et al., 2014). In this project, we calculated two of such characteristics.

The first concept is the *size of the activity space*. It is meant to capture the spatial extent and the degree of a person's mobility. It can be measured in a variety of ways. In this project, we applied the individualized residential exposure model (IREM), a novel approach introduced by Hasanzadeh et al. (2018) and described there in detail. It accounts for the residential location, distribution of all the locations within the Reykjavik Capital Region marked by a person as visited in the questionnaire, the shortest paths between home and visited the location, reported travel modes used to reach these activities, and buffers around these locations and routes (Figure 2). Based on the data, the model estimates the exposure of individuals to the urban environment. The higher the frequency of travel and the slower the more of transport, the higher the exposure. Areas with more than 50% exposure were extracted as polygons and their areas in hectares were calculated as the size of activity spaces.

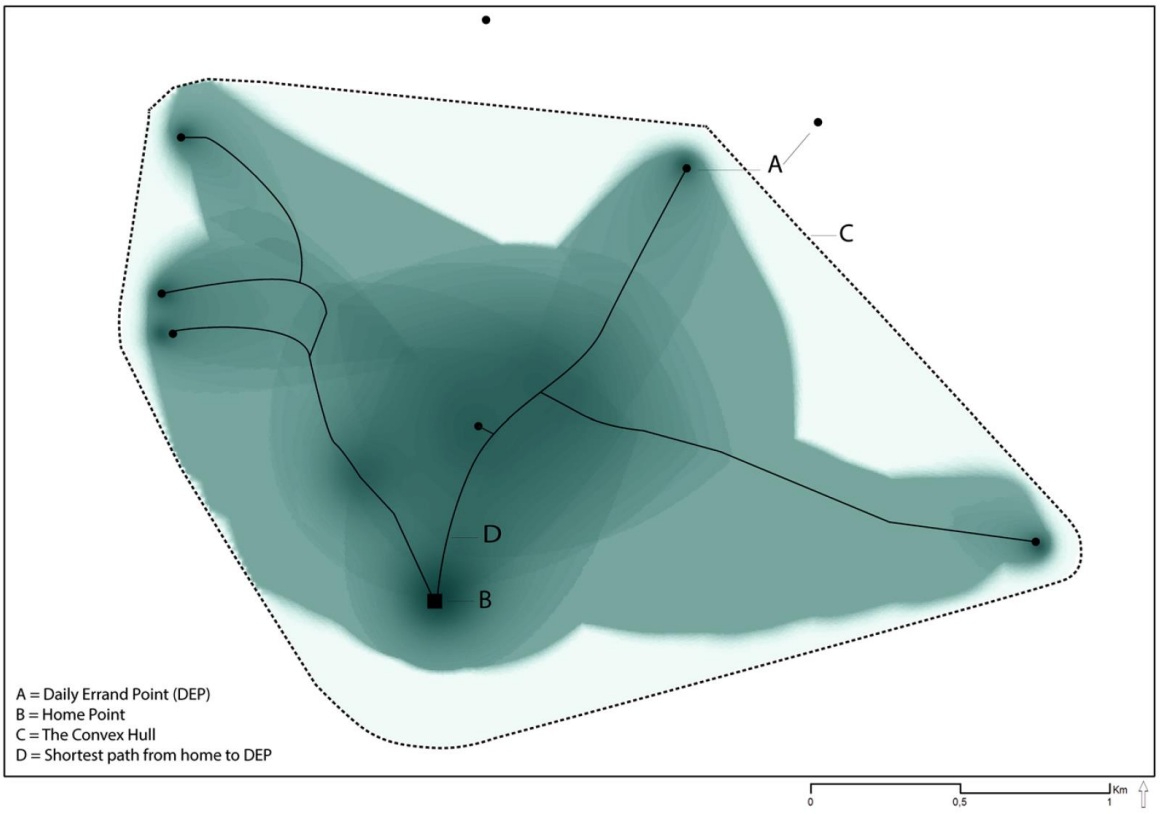

Figure 2. An exemplary local activity space model of an individual study participant reproduced from Hasanzadeh et al. (2018).

The second concept is the activity space *polycentricity*. It is used to identify whether someone's activities concentrate around one or multiple centers. Contrary to size, it does not necessarily capture the degree or amount of mobility, but rather its concentration around specific locations. According to Flamm and Kaufmann (2006), personal networks of typical places consist of *daily life centers* and *clusters of activity places*. Daily life centers are places in which people spend considerable time and consider them important in their everyday lives, such as home or workplace. Minor activities, such as services and social activities, often cluster around these centers. The centers have also been described as *activity anchor points* (Schönfelder & Axhausen, 2003). In our calculations, we identified the centers as spatial clusters containing activity locations within 1000 m distance from each other (Hasanzadeh, 2019). We then counted the number of centers in each per person's activity space and grouped them into monocentric, bicentric and polycentric

2.6 Qualitative data collection

The qualitative data collected was in the form of ten face-to-face interviews, performed in Icelandic. This section presents the formulation of the protocol, the pilot interviews and the first round of interviews.

The protocol was designed based on trends found in the quantitative data analysis, and then the questions were cross-referenced to any possible hypotheses and research questions which were formulated based on previous research and the Icelandic survey data.

Several people of the focus age range (25-40) were contacted to test the protocol and interview methods with the aim of having the group as diverse as possible, mainly regarding main transport modes and residential locations. Pilots were performed on 10 people, in English, Polish and Icelandic, mostly with face-to-face interviews but also via video calls. The pilot interviews were recorded and most transcribed, and translated into English if needed. During this process, the protocol was enhanced by adding questions on interesting issues that came up and removing redundant ones.

A diverse group of 30 interviewees was selected from the pool of survey respondents for the first round of interviews. The selected group was diverse and was picked based on car ownership, household type, residential location, employment status, income, and main travel modes. Invitations to participate were sent out via the emails that participants of the survey provided when they expressed willingness to participate in further research. Two cinema tickets were offered to each selected interviewee to maximize the response rate. The invitations were sent out in the language that the participant chose for the survey, Icelandic, Polish or English. A choice of taking part in the interview face-to-face or by video call was offered. 10 replied (33% response rate), all Icelandic, and all willing to take part face-to-face. The interviews lasted for a duration of 45-90 minutes and took place at our office, at cafés, and at the interviewee's homes. They were recorded, transcribed and translated into English.

Another group of 30 participants has been chosen for the second round of interviews. The process is ongoing.

3 Mobility styles of Reykjavik young adults

The concept of *mobility styles* relates travel behaviors to socio-economic characteristics, lifestyles, and personal preferences or attitudes of people (Große et al., 2018). It is applied through segmentation techniques, i.e. grouping people based on similarities and differences of their characteristics. The segmentation is typically based on preferences and attitudes related to mobility (Anable, 2005; Ohnmacht et al., 2009; Barr and Prillwitz, 2012), or observed patterns of travel behavior (Große et al., 2018). The latter is referred to as *modality styles*, as it emphasized travel mode choices made by study participants. Some studies take an integrated approach, in which attitude-based segmentation is compared with the one based on travel behaviors performed in various settings (Prillwitz and Barr, 2011). Some recent studies also account for more sophisticated descriptions of travel patterns that go beyond mode choices and distances, instead focusing on the geometric and thematic content of *activity spaces* (Hasanzadeh et al., 2019). To provide a comprehensive view of the mobility of young adults of the region, we included all of these approaches in this report.

Application of the mobility style segmentation provides insight into a differential role that urban form and socio-cultural aspects play in shaping mobility behavior of urban residents. It can also provide a knowledge-base for social marketing campaigns targeted at specific groups in order to motivate them to change or sustain their mobility behaviors (Haustein and Hunecke, 2013; Julsrud, 2014).

In the remainder of this chapter, we describe methods, present results, and interpret them in the context of land-use and transportation planning in Reykjavík Capital Region. Firstly, we present a segmentation based on travel mode choices in local travel (i.e. *modality styles*). Secondly, we present a segmentation based on attitudes and preferences related to daily travel, leisure travel, residential location, and environmental concern. In each of the sections, we provide a description of socio-demographic characteristics, detailed insight into travel patterns in various spatial scale, analysis of geographical distribution, and comparison of GHG emissions of the segments.

3.1 Modality styles

Background

The first type of segmentation applied to the data set is based on travel modes used in local mobility within the Capital Region. The segments represent distinct *modality styles* (Große et al., 2018). The approach taken in this analysis is akin to that of previous research. Prillwitz & Barr (2011) grouped participants based on the most frequently used travel modes for seven types of destinations. Große et al. (2018) grouped their respondents based on their primary travel mode to work or education, and the travel mode(s) to get to leisure activities in daily life. Julsrud (2014) employed more than 30 variables describing the mode of travel, the purpose of travel, number of trips, access to transport resources (e.g. car and bicycle ownership, access to PT), the total length of travel during a day, and key demographic

variables. Our approach differs from the latter in the selection of variables: we use only travel mode shares to define the segments, and use other variables to describe their characteristics.

Materials and Methods

The grouping of participants into *modality styles* was carried out in the following steps.

7) Firstly, we calculated variables used to define the clusters. These were eight variables taken from *softGIS* data about destinations visited within the Reykjavík Capital Region: 1) the share of travel modes to work- or study places (i.e. commuting destinations), weighted by trip frequency, represented with four ratio variables, one per each travel mode (car, bus, foot, and bicycle), 2) the share of travel modes to non-commuting destinations, weighted by trip frequency, represented with four ratio variables, one per each travel mode (car, bus, foot, and bicycle).
8) Secondly, we applied an agglomerative hierarchical method with Ward's method and squared Euclidean distance, using a *hclust* package in R. After examining the clustering tree, and summary of travel behaviors of each cluster, we decided to retain six clusters.
9) Thirdly, we labeled the clusters for easier interpretability and communication, using the most discernible characteristics of their members' travel behavior. The names are *Bus commuters, Consistent car commuters, Non-commuters, Multi-modal car commuters, Pedestrian commuters, Bicycle commuters*.
10) Fourthly, we compared characteristics of the clusters by applying multiple descriptive statistics to the following variables:
    a. Socio-demographic and lifestyle characteristics: age, gender, household composition, employment status, income, education level, language used to fill out the survey.
    b. Residential location: travel-related urban zones, average distance to the main city center.
    c. Local mobility: car ownership, yearly distances traveled with travel modes, the share of activities of various kind, GHG emissions associated with local travel
    d. Long-distance mobility: yearly number of domestic and international trips (leisure and business), GHG emissions associated with local domestic and international travel (leisure and business)
    e. Activity space characteristics: centricity and average size.

Results

The most populous *modality style* was the *consistent car commuters*, comprised of 258 study participants (36% of the sample). The vast majority of their trips made within Reykjavík Capital Region are done with cars, with only 9% of their non-commuting trips made on foot.

The second most populous group are the *multi-modal car commuters*, comprised of 148 individuals (21%). They also predominantly use cars to get to their work- or study places, only seldom substituting it with other travel modes (e.g. bus). They differ from the former group in that around half (52%) of their non-commuting trips are made on foot, and some of these trips (6%) are made on bicycles.

The next group is comprised of the *non-commuters*, the 101 members of our sample (14%) who did not report any trips to work- or study places. In their non-commuting trips, they predominantly use cars (63% of trips) and walking (28% of trips).

The *pedestrian commuters* include 90 study participants (13% of the sample). The vast majority (89%) of their commuting trips are made on foot, only sometimes substituted by other travel modes, such as a car (6% of trips). They also predominantly walk to non-commuting destinations (58% of trips). Interestingly, 34% of their non-commuting trips are made by cars.

The *bus commuters* comprise of 60 individuals (8% of the sample). The majority (82%) of their trips are made by bus, sometimes (in 10% of trips) substituted with a car or other travel modes. They are multi-modal in their non-commuting trips: 37% of these are made by cars, 36% by walking, and only 22% by bus.

The *bicycle commuters* group is similarly as populous as the *bus commuters* group: it comprises of 60 individuals, and 8% of our sample. Most (78%) of their commuting trips are made by bicycle, substituted at times with trips by car (11%) or walking (6%). They are multi-modal in their non-commuting travel, but avoid using buses: 34% of their trips are made either by bicycle or car, and 30% are made on foot.

Table 3. The structure of travel modes in local travel (i.e. within the Reykjavik Capital Region) of the modality styles members

				Commuting				Non-commuting			
No		Cluster	N	Car	Bus	Foot	Bicycle	Car	Bus	Foot	Bicycle
1		Bus commuters	60	10%	82%	4%	5%	37%	22%	36%	5%
2		Consistent car commuters	258	91%	3%	3%	3%	88%	1%	9%	2%
3		Non-commuters	101	-	-	-	-	63%	4%	28%	5%
4		Multi-modal car commuters	148	88%	7%	3%	2%	41%	1%	52%	6%
5		Pedestrian commuters	90	6%	1%	89%	3%	34%	4%	58%	4%
6		Bicycle commuters	60	11%	4%	6%	78%	34%	2%	30%	34%
		Summary	717	62%	11%	16%	10%	60%	4%	30%	6%

Socio-demographic characteristics

Even though there are many similarities between people with different *modality styles* in terms of their socio-demographic characteristics, there are also some marked differences summarized in a table below.

	Compared to other groups, the *consistent car commuters* are somewhat more likely to be employed full time and have on average slightly higher incomes.
	The *multi-modal car commuters* are also likely to be employed full-time. They tend to have a graduate-level education and be in a household with a child or children. Both car-commuting groups have a higher percentage of Icelandic speaking people than the whole sample.
	*Non-commuters* have a high percentage of women. Even though 52% of them report being fully employed, they are also likely to be stay-at-home parents, unemployed, or unable to work. On average, this group has lower incomes and education levels than other groups, and have a higher percentage of non-Icelandic speaking people.
	The *pedestrian commuters* are more likely than other groups to be employed part-time, self-employed or entrepreneurs. Even if 40% of them are in households with children, the group has a relatively high percentage of childless couples and single households.
	Those who *commute by bus* are predominantly men, have on average a lower level of education and lower incomes. They have a high percentage of single households and non-Icelandic speaking people.
	The *bicycle commuters* are somewhat more likely to be men, employed full-time or studying, with graduate or postgraduate education, single, and Icelandic speaking.

Table 4. Socio-demographic characteristics of the members of the modality styles

Variables		Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	**Sample**
Gender	Female	48%	62%	69%	58%	66%	55%	61%
	Male	52%	38%	31%	42%	34%	45%	39%
Employment status	Employed full time	68%	78%	52%	74%	58%	80%	70%
	Employed part time	5%	5%	5%	7%	11%	2%	6%
	Self-employed/Entrepreneur	5%	3%	4%	4%	12%	0%	5%
	Stay-at-home-parent/ Paternity or maternity leave	3%	3%	11%	5%	2%	0%	4%
	Student	14%	9%	5%	8%	13%	15%	10%
	Unable to work	2%	0%	12%	1%	1%	2%	3%
	Unemployed	3%	0%	9%	0%	1%	0%	2%
	Other	0%	1%	2%	1%	1%	2%	1%
Education level	Basic education	11%	7%	14%	5%	8%	3%	8%
	Vocational education	11%	8%	12%	6%	2%	5%	7%
	Secondary education	21%	14%	20%	15%	20%	7%	16%
	Undergraduate level	30%	36%	26%	28%	35%	33%	32%
	Graduate level	25%	33%	22%	40%	31%	40%	33%
	Postgraduate level	2%	2%	6%	7%	3%	12%	5%
Household type	Couple with child/children	30%	52%	52%	61%	40%	50%	50%
	Couple living together	23%	22%	12%	20%	25%	15%	20%
	Single person without children	42%	16%	26%	14%	25%	30%	22%
	Single parent with child/children	0%	8%	5%	3%	5%	2%	5%
	Other	5%	2%	5%	2%	4%	3%	3%
Monthly income per consumption unit	Very low (below 290k kr)	23%	12%	40%	15%	21%	11%	18%
	Low (290k to 390k kr)	39%	16%	22%	20%	23%	21%	21%
	Medium (390k to 510k kr)	18%	28%	15%	24%	25%	26%	24%
	High (510k to 670k kr)	12%	27%	18%	25%	15%	23%	22%
	Very high (above 670k kr)	9%	17%	5%	16%	16%	19%	15%
Survey language	Icelandic	75%	86%	72%	88%	81%	90%	83%
	English	22%	11%	19%	8%	17%	8%	13%
	Polish	3%	3%	9%	4%	2%	2%	4%

Residential location

There are differences between the modality styles in terms of their residential location. However, membership in the groups is not determined by geography, and there are other factors in play. Compared to other groups, the *consistent car commuters* are more likely to live far away from the city center (7.34 km, on average), in car-oriented urban zones with poor access to public transportation. The *multi-modal car commuters* also live relatively far from the city center (6.27 km, which is close to the sample average) and often in the car-oriented urban zone. Compared to other groups, they are more likely to live close to the sub-centers (14% compared to 7% in the whole sample), which suggests that their use of walking for non-commuting trips is influenced by proximity to services. The *non-commuters* live relatively far away from the city center (6.49 km) and are somewhat more likely to live in places with decent access to public transportation than members of the other groups. The *pedestrian commuters* live relatively close to the city center, albeit this distance is often considerable (4.10 km, on average). They are more likely to live in the central pedestrian zone or its fringe (33% and 29%, respectively), but still, 25% of them lives in the car-oriented zone. The *bus commuters* live on average 5.8 km from the city center. Compared to other groups, they are somewhat more likely to live in the central pedestrian zone and its fringe, and less likely to live in the car-oriented zone. Their residential location seems to be unaffected by access to public transportation or proximity to the sub-centers. The *bicycle commuters* live relatively close to the city center (4.52 km) and are more likely than other groups to live in the fringe of the central pedestrian zones (33% compared to 22% in the whole sample.

Table 5. Distribution of the modality styles in the travel-based urban zones of the region.

No	Clusters	Travel-related urban zones							N
		Central pedestrian zone	The fringe of the central pedestrian zone	Intensive public transportation zone	Pedestrian zones of the sub-centers	Basic public transportation zone	Car-oriented zone	Average distance to the city center	
1	Bus commuters	18%	28%	2%	7%	17%	28%	5.80	60
2	Consistent car commuters	7%	17%	4%	5%	25%	42%	7.34	257
3	Non-commuters	11%	21%	9%	11%	14%	35%	6.49	81
4	Multi-modal car commuters	14%	20%	4%	14%	12%	37%	6.27	147
5	Pedestrian commuters	33%	29%	3%	1%	9%	25%	4.10	91
6	Bicycle commuters	20%	33%	2%	7%	12%	27%	4.52	60
	Summary	14%	22%	4%	7%	17%	35%	6.21	696

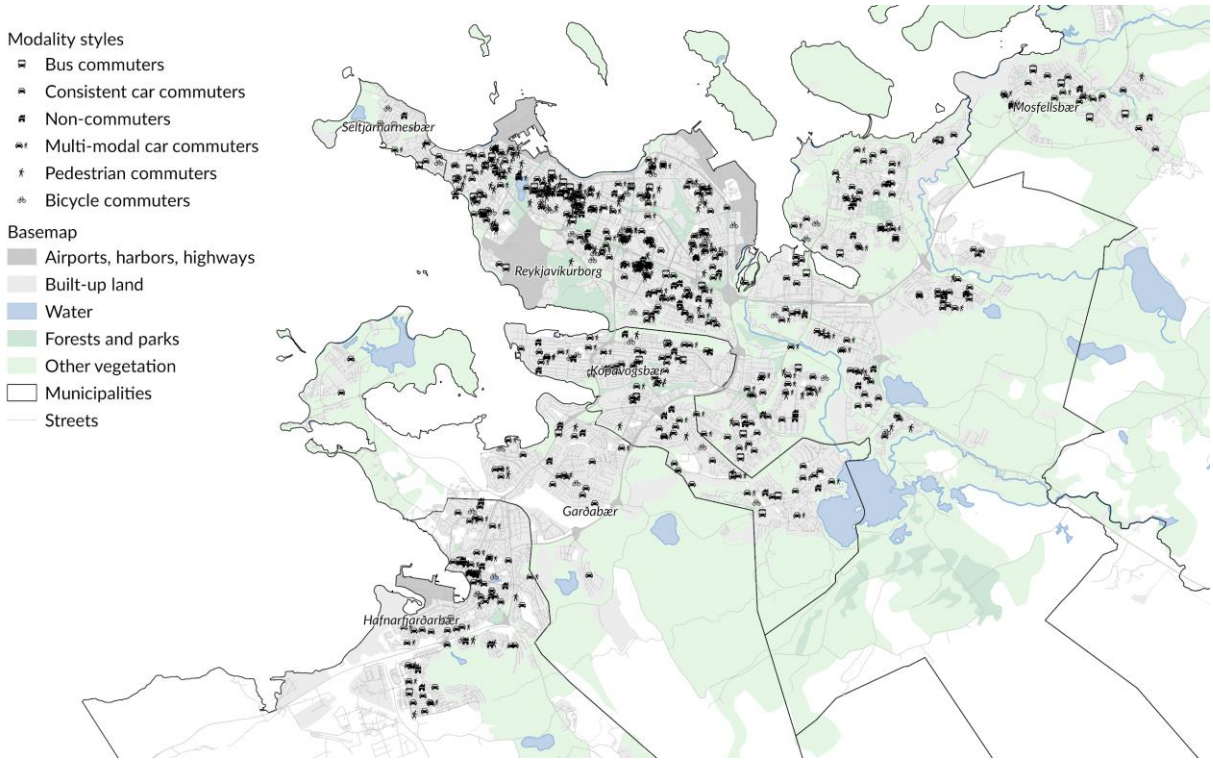

Figure 3. Geographical distribution of study participant with distinct modality styles in the Reykjavik Capital Region

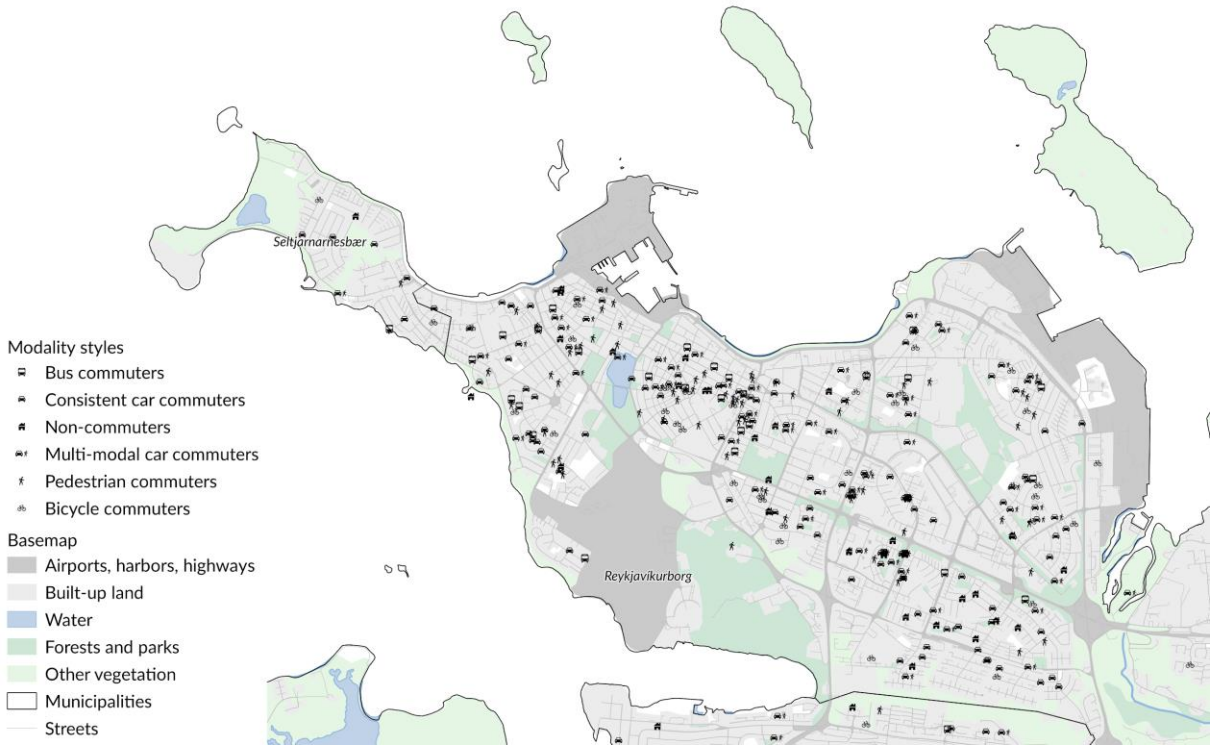

Figure 4. Geographical distribution of study participant with distinct modality styles in the Reykjavik Capital Region - a highlight on the central part of Reykjavík and Seltjarnarnes.

Table 6. Distribution of different mobility styles within the postal codes of the Reykjavik Capital Region

Postcode	Neighborhood/ Municipality	Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	N
								
101	Miðbær	13%	17%	11%	17%	31%	12%	**84**
103	Háaleiti og Bústaðir	10%	37%	22%	24%	7%	0%	**41**
104	Laugardalur	5%	34%	5%	20%	17%	20%	**41**
105	Hlíðar	9%	24%	7%	24%	19%	17%	**70**
107	Vesturbær	18%	39%	0%	9%	21%	12%	**33**
108	Háaleiti og Bústaðir	6%	35%	15%	20%	14%	11%	**66**
109	Breiðholt	10%	50%	5%	30%	5%	0%	**20**
110	Árbær	3%	46%	8%	32%	5%	5%	**37**
111	Breiðholt	6%	22%	17%	33%	17%	6%	**18**
112	Grafarvogur	5%	54%	10%	23%	3%	5%	**39**
113	Grafarholt og Úlfarsárdalur	5%	70%	15%	5%	5%	0%	**20**
170	Seltjarnarnes	0%	50%	10%	10%	10%	20%	**10**
200	Kópavogur	11%	37%	17%	26%	2%	7%	**46**
201	Kópavogur	9%	41%	9%	23%	14%	5%	**22**
203	Kópavogur	14%	36%	14%	29%	0%	7%	**14**
210	Garðabær	4%	40%	12%	24%	12%	8%	**25**
220	Hafnarfjörður	6%	47%	16%	20%	4%	6%	**49**
221	Hafnarfjörður	8%	38%	15%	19%	15%	4%	**26**
270	Mosfellsbær	15%	42%	12%	19%	8%	4%	**26**
Sample		**9%**	**37%**	**12%**	**21%**	**13%**	**9%**	**687**

Unsurprisingly, considering their travel patterns, the *consistent car commuters* and the *multi-modal car commuters* live in households with at least one car. They are also more likely than other groups to have more than one car in the household. Car ownership rate is very high in all groups, including those who mainly commute using other modes (80% among the *pedestrian commuters* and 72% among the *pedestrian commuters*), except for the *bus commuters*, among whom only 58% have a car in the household. The high car ownership rate among those who don't commute by cars can be explained in several ways. For instance, in households that own only one car, it may be other members of the household (e.g. spouses) who are using it for commuting. Additionally, in some households, the cars might be used for other trips than commuting, such as shopping or leisure trips made within the region or domestically.

This is reflected in the interviews, where those who did not own a car felt like they were missing out on domestic travel, or felt they were restricted when planning trips away from the

city. Those who owned a car, but usually commuted by foot, bicycle or bus said that although they were not dependent on their car for traveling around the city, they felt a sense of freedom and independence being able to get in their car and drive to the countryside.

The *consistent car commuters* are the most mobile both within the Reykjavik Capital Region and away from it. They have the highest total amount of emissions resulting from travel (Figure 5). They cover the longest distances in their local travel among all the groups (over 7 thousand km per year). They have relatively large activity spaces, often polycentric (49%), which means their activities concentrate around multiple locations (e.g. home, work, and other locations). Together with a very high proportion of trips made by cars, it results with the yearly amount of emissions from local travel of **1.6 tons of CO2eq per capita** (sample average is close to **1 ton**). Furthermore, they made on average 10.2 domestic leisure trips in the previous year (more than any other group), 2.3 domestic business trips, and had a high share or car use in these trips (89%), which resulted in **0.64 tons**, compared to the sample average of **0.54 tons**. They also are the most frequent flyers with **2.34 international leisure trips per year**, compared to the sample average of two trips. The GHG emissions resulting from international trips of this group amount to **5.1 tons** per person, of which **3.3 tons** results from trips unrelated to their work or studies.

Travel patterns and related emissions of the *multimodal car commuters* are similar to the previous group, albeit they do travel somewhat shorter distances. Their activity spaces within the urban region are the largest among all the groups, and they are typically concentrated around two locations (45% are bicentric). Firstly, the emissions from their non-commuting local trips are lower due to the lower proportion of car use. The emissions from their local trips amount to **1.4 tons** per year per person. They make an average number of domestic leisure trips per year (ca 8.35), and a high number of domestic business trips (ca 2.7). The vast majority of these trips were made by car (91%), which resulted in relatively high domestic travel emissions of **0.53 ton** per year per person. They made respectively 1.84 and 1.27 leisure and business trips abroad in the previous year, which resulted in **4.5 tons** of GHG emissions per person.

The *bicycle commuters* had much lower GHG emissions resulting from local travel, even if not zero due to occasional car use - just about **0.3 tons** per capita. Characteristics of their activity spaces are close to that of an average person in our sample. Their long-distance travel also did not differ much from the average. They made on average 7.8 leisure and 2.1 business trips within Iceland, mostly by car (84%), which resulted in about **0.5 ton** of GHG emissions per person. They also undertook on average around two leisure trips, and one business trip abroad in the previous year, generating an average of **4.7 tons** of GHG emissions from international travel per person.

The *pedestrian commuters* had the smallest carbon footprint of the travel within the Reykjavik Capital Region, just below **0.3 tons**. They also have the smallest activity spaces among all groups, and 60% of them are monocentric, which means that they are concentrated around just one location, most typically home. Numbers of their leisure trips away from the region was just about average for our sample (8.4 domestic trips and 2 international trips), but they made somewhat fewer business trips than the average study participant (2 domestic and 0.5 international, compared to the averages of 2.3 and 0.9). Their yearly domestic travel emissions amounted to **0.44 tons**, and their international travel emissions averaged at **3.5 tons**. The total amount of travel-related GHG emissions in this group was estimated at **4.2 tons**.

The *bus commuters* had a similar total amount of emissions than the *pedestrian commuters* had (**4.3 tons**), but a different structure. Their average GHG emissions from local travel were estimated at **0.84 tons**, but their emissions from long-distance travel were somewhat smaller: **0.45 tons** from domestic trips and **3 tons** from trips abroad. They made on average less long-distance trips than the other groups: 6.3 domestic leisure trips, 1.9 domestic business trips, 1.9 international leisure trips, and 0.6 international business trips. Interestingly, only 14% of their domestic trips were made by bus, which is more than the average in our sample, but still a rather small number. They are quite mobile within the Capital Region: have relatively large activity spaces, that are likely to be bicentric (37%) or polycentric (41%).

The *non-commuters* were the least mobile group in the sample and a group with the lowest climate impact generated from travel (ca **3.8 tons**). Their local activity spaces are small and often monocentric (46%). Their average yearly emissions from local travel were estimated at just below **0.4 tons**. They also traveled less than any other group within Iceland, and internationally. They made on average 5.9 domestic leisure trips, 2 domestic business trips, 1.5 leisure trips abroad, and 0.5 business trips abroad. Their average yearly emissions from long-distance travel amounted to **0.5 tons** from domestic trips and **2.9 tons** from trips abroad.

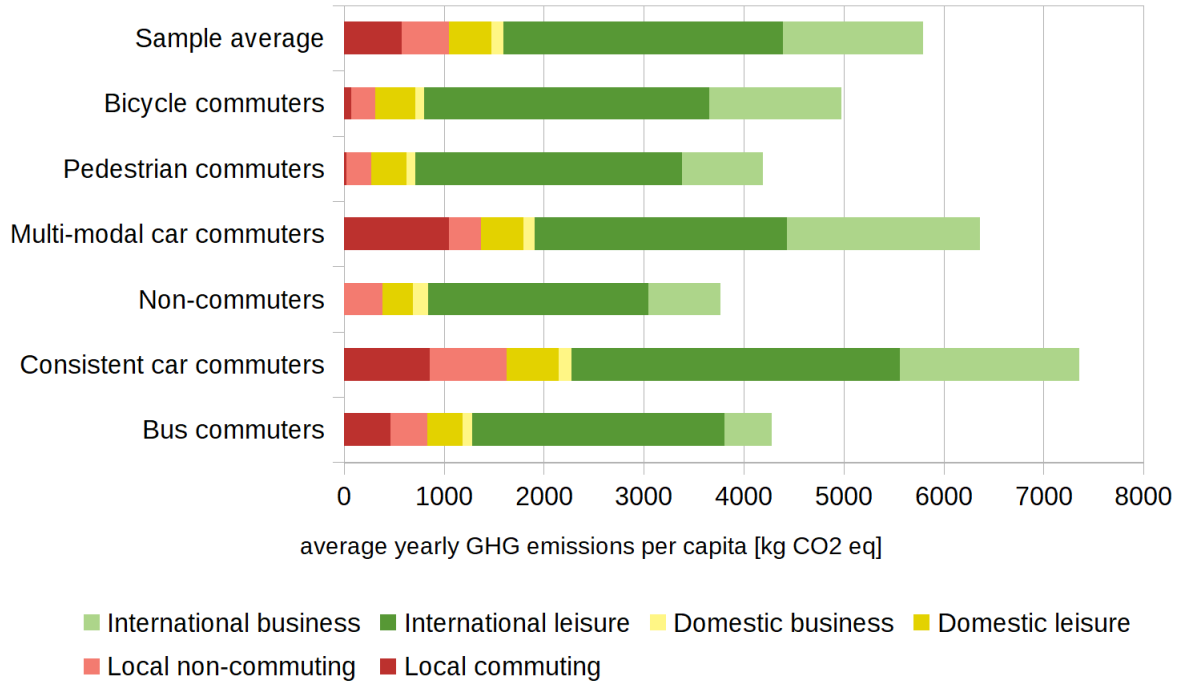

Figure 5. Yearly average travel-related GHG emissions per member of the different modality styles

Table 7. A summary of local travel patterns (i.e. made within the Reykjavik Capital Region) of the members of different modality styles

Variables		Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	**Sample**
Cars in the household	None	42%	1%	13%	2%	28%	20%	11%
	One	48%	52%	43%	61%	56%	72%	54%
	Two	7%	40%	32%	35%	12%	7%	29%
	More than two	3%	8%	13%	1%	4%	2%	6%
Average yearly distances in local travel per capita [km]	Car	1348	6726	1630	5817	1127	1172	4201
	Bus	3748	152	97	363	67	202	482
	Foot	539	199	313	571	487	256	361
	Bicycle	159	48	55	104	53	710	126
	Total	5794	7125	2095	6855	1734	2340	5170
Average yearly GHG emissions from local travel per capita [kg CO_2 eq]	Car	297	1608	369	1320	261	286	984
	Bus	540	22	14	52	10	29	69
	All travel modes	837	1630	383	1373	271	315	1054
	Commuting trips	466	860	0	1052	27	75	575
	Non-commuting trips	371	770	383	320	244	240	479
	All trips	837	1630	383	1373	271	315	1054
Share of different types of activities in local trips	Work- or study place	47%	43%	1%	51%	45%	39%	39%
	Shopping	13%	15%	32%	12%	15%	14%	17%
	Services and errands	7%	4%	9%	3%	5%	5%	5%
	Daycare, kindergarten, school or after-school activities	11%	16%	19%	17%	14%	19%	16%
	Culture and sports events	3%	2%	7%	1%	3%	3%	3%
	Leisure and going out	6%	3%	7%	3%	7%	5%	4%
	Sport and active recreation	10%	14%	20%	11%	10%	12%	13%
	Other	3%	3%	5%	1%	2%	2%	3%
Centricity of activity spaces	Monocentric	22%	14%	46%	18%	60%	27%	27%
	Bicentric	37%	37%	33%	45%	15%	37%	35%
	Polycentric	41%	49%	21%	37%	24%	36%	38%
Average size of activity space [hectares]		321	312	208	350	193	289	291

Table 8. A summary of long-distance travel patterns (i.e. made away from the Reykjavik City Region, domestically and internationally) of the members of different modality styles.

Variables		Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	**Sample**
Average yearly GHG emissions from long-distance travel per capita [kg CO_2 eq]	Domestic leisure trips	353	520	311	422	356	398	426
	Domestic business trips	94	123	145	117	86	90	115
	Domestic trips	447	643	456	539	442	488	541
	International leisure trips	2520	3289	2205	2518	2673	2851	2799
	International business trips	480	1794	720	1933	810	1327	1398
	International trips	3000	5083	2925	4452	3483	4178	4198
	All leisure trips	2873	3810	2516	2940	3029	3249	3225
	All business trips	573	1917	865	2051	896	1417	1513
	All long-distance trips	3447	5726	3381	4991	3925	4666	4738
Average yearly number of long-distance trips per capita	Domestic leisure trips	6.32	10.19	5.85	8.33	8.40	7.82	8.45
	Domestic business trips	1.93	2.28	2.02	2.69	2.04	2.05	2.25
	International leisure trips	1.87	2.34	1.53	1.84	2.02	2.03	2.02
	International business trips	0.55	1.09	0.45	1.27	0.51	1.00	0.91
Travel mode shares in domestic trips	Car	78%	89%	86%	91%	81%	84%	87%
	Plane	6%	5%	6%	5%	6%	5%	5%
	Bus	14%	2%	6%	3%	9%	10%	5%
	Boat	2%	3%	1%	2%	4%	1%	3%

3.2 Preferences and attitudes

Background

Another type of segmentation used in transportation studies and this report are *mobility styles* based on personal attitudes related to the environment, climate change, leisure travel, daily travel, and residential environments. It follows an approach adopted by Anable (2005), Ohnmacht et al. (2009), Prillwitz and Barr (2011) and others. The idea behind such segmentation and analysis of such psychological factors in transportation research is that they influence travel behaviors along with the urban form and socio-demographic situation (Anable, 2005; Hunecke et al., 2007).

Previous research has found that, even if attitudes and behaviors align to some extent, the alignment is seldom complete (Prillwitz and Barr, 2011). It is thus instrumental for land-use and transportation planning to study relationships between them. Such knowledge can help guide actions aimed at changing behavioral patterns for instance by identifying target groups for social marketing campaigns (Haustein and Hunecke, 2013). It may also help distinguish

between the effects of planning and the effects of "soft" (i.e. cultural, social, and psychological) variables on travel behavior. One of the ways the urban form and soft variables interact is through residential self-selection (Manaugh and El-Geneidy, 2015). The concept explains a situation in which urban residents choose their residential location according to their preferences for certain travel modes. Even though its role in transportation studies is debated (e.g. Næss, 2014), knowing the distribution of different preferences and attitudes in the city, and their influence on residential choices may provide important insights into land-use and transportation planning.

Attitude-based mobility styles have also been used to study the environmental impacts of long-distance travel. As previous research illustrates, the pro-environmental attitudes and climate change awareness are not correlated with reductions in long-distance travel (Prillwitz & Barr, 2011; Alcock et al., 2017).

Methods

The present analysis is based on answers to 34 statements from the softGIS survey (17 statements on page 11, and 17 on page 12) referring to attitudes and views related to the environment, pro-environmental behaviors, climate change, cosmopolitanism, leisure travel, residential environments, and daily travel modes. The whole list of items is presented in Table 9 and Table 10. Responses to the items were given on a five-step scale from 1 to 5 with the following labels: 1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree. 525 respondents answered to all statements and were included in the following analyses.

To reduce the number of variables, the factors analyses (i.e. principal axis factoring with oblique rotation) were performed separately on answers to the questions from each page. The results of factor analyses are presented in Table 9 and Table 10. The factor scores were then estimated and used in subsequent analyses: describing attitudes and preferences of people with different *modality styles* and analyzing the spatial association of attitudes within the urban region.

Because the factor solutions explained only a relatively low proportion of variance and the number of items was relatively low, further steps of the mobility style segmentation were conducted on the original answers to the questions. This is different from previous studies, in which summed answers to items contributing to each factor were used (e.g. Prillwitz & Barr, 2011; Anable, 2005).

To see whether certain attitudes or preferences cluster spatially in the Capital Region, we performed a global autocorrelation analysis of attitudinal factor scores using Moran's *I* statistic and a local autocorrelation analysis using Hotspot Getis-Ord Gi* method, both in ArcGIS 10.6 (Esri, 2018a,b). The former provides an indication of whether a variable is clustered spatially, and the latter shows in which areas of the region values higher or lower than the average for the whole region are concentrated.

Results

Four-factor solutions were retained in each analysis, together yielding eight factors:

1. *Pro-environmental attitude*,
2. *Climate change awareness,*
3. *A cosmopolitan attitude in travel,*
4. *Preference for urban vs. natural settings in travel,*
5. *Suburban preference,*
6. *Pro-car attitude,*
7. *Preference for shared housing and transport,*
8. *Preference for nature and privacy.*

The factors summarize answers to individual questions that correlate with each other and are usually similar in thematic content.

Respondents who score highly on the *pro-environmental attitude* are concerned with environmental issues, want to live ecologically, and are willing to reduce their environmental impacts when buying products and services or traveling.

Those who score highly on the *climate change awareness* agree that there is evidence of global climate change, that it's caused by human activities, and will bring about serious negative consequences.

Those with *cosmopolitan attitude in travel* consider exploring new places and cultures important, to some even at the expense of natural resources. They also tend to be at ease with traveling and being in different places in the world.

Respondents with a high *preference for urban vs. natural settings in travel* tend to favor cities over forests or wilderness areas as settings for their leisure travel. They rarely think they need to take a break from urban life.

Those with high *suburban preference* consider suburbs their favorite residential environment and want to live there even if it means traveling longer distances. They don’t consider the suburban life boring, but indeed value calmness and tranquility over liveliness in their neighborhoods.

Those with a *pro-car attitude* prefer getting around the city by car and not other modes of transport such as walking, cycling or public transportation.

Those with a high *preference for shared housing and transport* are in favor of urban density: they are comfortable living in apartment buildings close to their neighbors. They don’t mind sharing rides with strangers and like when there is a lot going on in their neighborhoods.

Respondents with a high *preference for nature and privacy* like having private yards or natural areas close to their homes. They are in favor of single-family houses in calm areas. They also tend to prefer moving around in an active way (i.e. by walking or cycling).

Table 9. Rotated factor loadings retained in four-factor solution. Answers to statements on page 11/14 Please state how much you agree or disagree with statements below (1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree).

	Factor 1	Factor 2	Factor 3	Factor 4
Item	Pro-environmental attitude	Climate change awareness	A cosmopolitan attitude in travel	Preference for urban vs. natural settings in travel
I want to live as ecologically as possible	0.572			
I am very concerned about environmental issues	0.538	0.314		
I think about how I can reduce environmental damage when I go on holiday	0.776			
I think about the environmental impact of services I use	0.810			
When shopping, I rarely think about the environmental impact of the things I buy	-0.528			
I am willing to reduce my use of air travel because of the environment	0.484			
Experiencing different cultures is very important for me			0.687	
Experiencing different cultures and destinations is more important than saving natural resources			0.355	
Exploring new places is an important part of my lifestyle			0.826	
It is easy for me to jump to a plane and go on a trip			0.383	
I feel at home wherever in the world I go			0.332	
Sometimes it is necessary to take a break from urban life			0.237	-0.295
I find it more interesting on a city street than out in the forest looking at trees and birds				0.682
I would rather spend my weekend in the city than in wilderness areas				0.790
There is evidence of global climate change		0.754		
The main causes of global warming are human activities		0.826		
Global warming will bring about some serious negative consequences		0.858		

Table 10. Rotated factor loadings retained in four-factor solution. Answers to statements on page 12/14 Please state how much you agree or disagree with statements below (1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree).

	Factor1	Factor2	Factor3	Factor4
Item	Suburban preference	Pro-car attitude	Preference for shared housing and transport	Preference for nature and privacy
I prefer to live in a suburban neighborhood, even if it means traveling longer distances	0.883			
If I could live anywhere I would live in the suburbs	0.827			
Suburban life is boring	-0.71			
I like living in a neighborhood where there is a lot going on	-0.509		0.336	
I don't mind traveling a bit longer for the everyday services I use	0.458			
I appreciate tranquility and calmness in a residential area	0.387			0.253
I want to live close to the vast nature and recreational areas	0.319			0.457
Having shops and services within walking distance of my home is important to me	-0.281			
The car is my preferred way of getting around the city		0.903		
I appreciate good travel connections by car		0.679		
I prefer getting around in an active way such as walking or cycling		-0.599		0.285
I don't mind getting around using public transportation		-0.548		
I can be comfortable living in close proximity to my neighbors			0.834	-0.285
Living in a multiple-family unit would not give me enough privacy			-0.459	0.583
I am comfortable riding with strangers			0.331	
The neighborhood park is enough nature for me			0.274	
I like to have a large yard at my home				0.523

Four among the eight factors show geographical clustering, i.e. their high or low values concentrate in certain parts of the Reykjavik Capital Region. There seem to be a relatively strong spatial sorting of residents based on their preferences. The strongest clustering was observed for the *suburban preference* factor (Table 11). Its low values concentrate in and around Reykjavik city center, and high values concentrate in the suburban areas (Figure 8). In comparison, clustering of the *pro-car attitude* is not as apparent (Figure 9). This implies that there are many suburban dwellers who do not actually prefer the private car as a travel mode choice. This highlights the importance of strengthening public transportation to the suburbs, bicycle- and footpaths and integrating workplaces into suburban neighborhoods. In our interviews, suburban residents expressed a lower quality of life having to commute in traffic into central parts of Reykjavík.

Comparing the two maps of *suburban preference* and *pro-car attitude* suggests that travel-mode related preferences are rarely a reason to reside in suburbs, but might motivate people to live close to the center in order to be able to move around by walking or cycling.

Another interesting insight from the geographical analysis of attitudes is that high values of *pro-environmental attitudes* and *cosmopolitan orientations in travel* concentrate in and around Reykjavík city center (Figure 6 and Figure 7), which is consistent with our previous research in Helsinki Metropolitan Area (Árnadóttir et al., in review).

Table 11. Patterns of spatial clustering of attitudinal factor scores.

Factor	**Moran's *I* *z*-score (p-value)**	**Hot spot analysis**
Pro-environmental attitude	5.02 (<.001 ***)	High values cluster around Reykjavík city center low values cluster in Mosfellsbær and (weakly) in Hafnarfjörður
Climate change awareness	1.08 (.278 ^{ns})	No significant spatial pattern of association
A cosmopolitan attitude in travel	4.35 (<.001 ***)	High values cluster around Reykjavík city center
Preference for urban vs. natural settings in travel	0.75 (.453 ^{ns})	No significant spatial pattern of association
Suburban preference	38.271 (<.001 ***)	Low values cluster within Reykjavík urban core (up to Elliðaárdalur and Fosvogsdalur), high values cluster in the outskirts: Mosfellsbær, Grafarholt, Grafarvogur Breiðholt, and (somewhat more weakly) Hafnarfjörður.
Pro-car attitude	4.04 (<.001 ***)	Low values cluster close to Reykjavík city center, in Miðbær and Vesturbær
Preference for shared housing and transport	0.11 (.915 ^{ns})	No significant spatial pattern of association
Preference for nature and privacy	0.64 (.525 ^{ns})	No significant spatial pattern of association

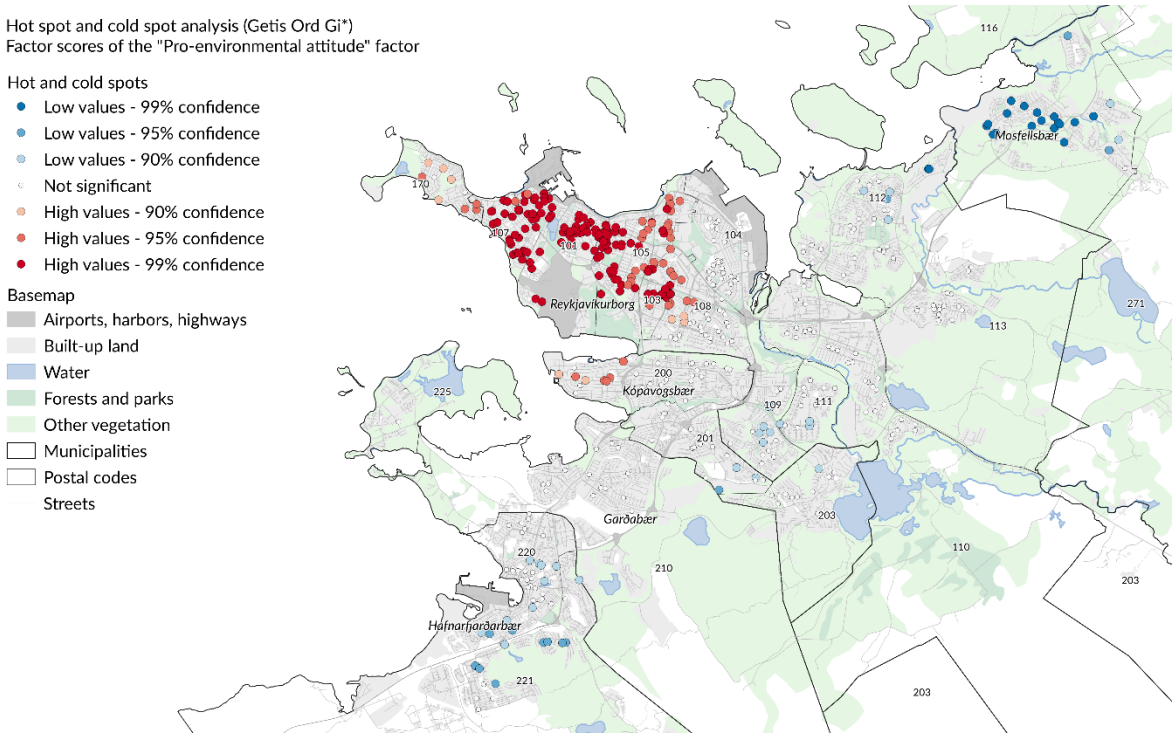

Figure 6. Hot spot and cold spot analysis of the factor scores of the "pro-environmental attitude" factor

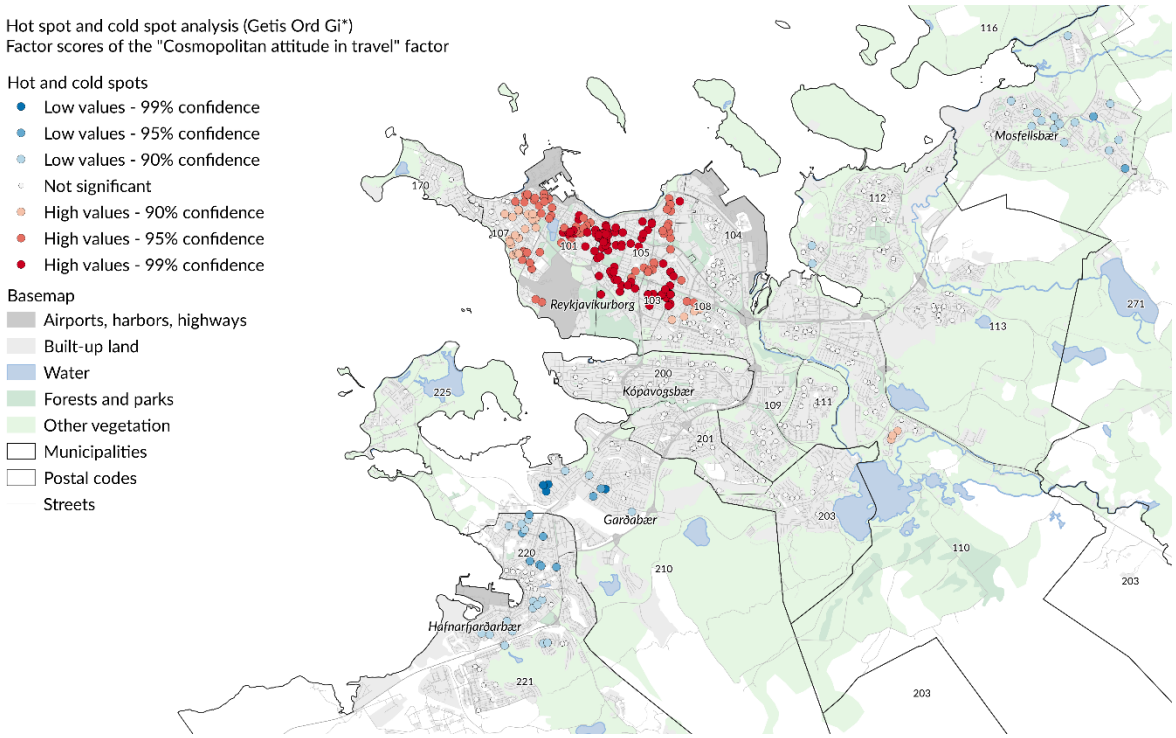

Figure 7. Hot spot and cold spot analysis of the factor scores of the "cosmopolitan attitude in travel" factor

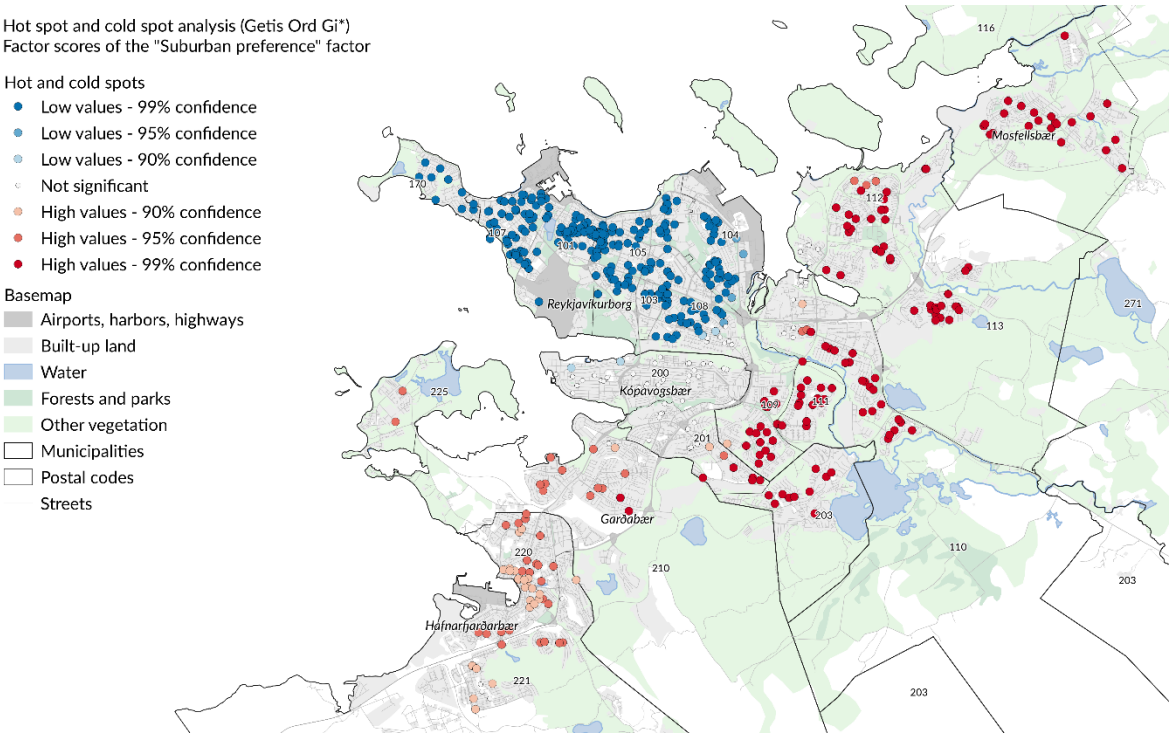

Figure 8. Hot spot and cold spot analysis of the factor scores of the "suburban preference" factor

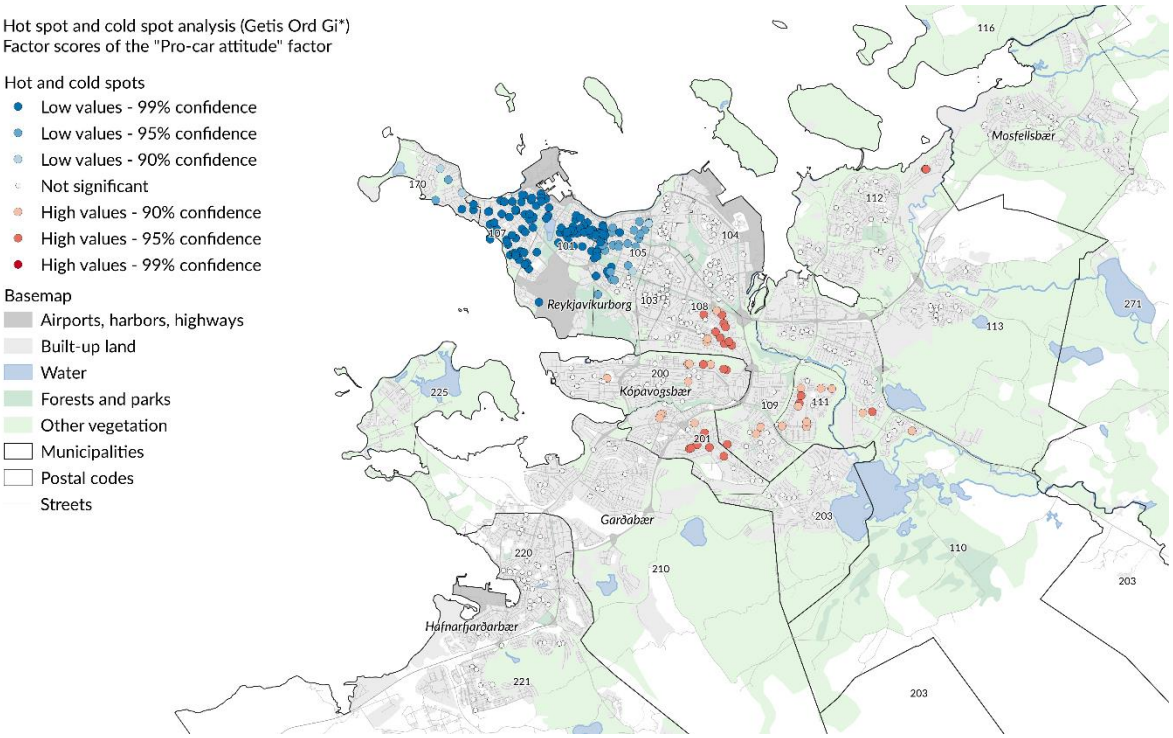

Figure 9. Hot spot and cold spot analysis of the factor scores of the "pro-car attitude" factor

Segmentation of the study participants based on their answers to the 34 statements about their attitudes and preferences allowed us to delineate six groups characterized in the table below.

Concerned pro-density urbanites (n=54)	Compared to other groups, they have a relatively high environmental concern and willingness to live ecologically. They are somewhat more cosmopolitan in their travel interests and tend to prefer urban environments both in leisure travel destinations and in a residential location. They strongly dislike suburban residential environments and are rather positive towards sharing apartments with others and living close to their neighbors. Compared to other groups, they are more likely to be students (15%), live in a single household (38%), speak Icelandic (93%), and have somewhat lower incomes than the average study participant.
Pro-car suburbanites (n=135)	Compared to other groups, they are somewhat more aware and concerned about climate change and are somewhat less cosmopolitan in their travel interests. They prefer natural environments as leisure travel destinations, as well as suburban and green residential locations. They have a positive attitude towards the car as a daily travel mode. Compared to other groups, they are more likely to be women and have somewhat higher incomes than the average respondent.
Unconcerned pro-car urbanites (n=55)	Compared to other groups, they have lower concern for the environment, willingness to live ecologically, and climate change awareness and concern. They tend to prefer urban environments in leisure travel and dislike suburban residential environments. They have a strongly positive attitude towards the car as a travel mode. Compared to other groups, they are more likely to be men, have basic education (13%) and lower incomes (47% of them belongs to the lowest group).
Anti-car environmentalists (n=94)	Compared to other groups, they have a very high level of environmental concern and willingness to live ecologically. They strongly dislike the car as a daily travel mode and instead opt for other travel modes. Compared to the other groups, they are more likely to be women, have higher education (11% of them has a postgraduate level degree), be in a couple with children (61%), and speak English (18%).
Unconcerned suburbanites (n=117)	Compared to other groups, they have lower environmental concern and willingness to live ecologically, as well as lower climate change awareness and concern. They also tend to be somewhat less cosmopolitan in their travel interests. They tend to prefer suburban residential environments. Compared to the other groups, they have slightly lower incomes and otherwise have characteristics close to the average of the sample.
Cosmopolitan urbanites (n=70)	Compared to other groups, they are much more cosmopolitan in their travel interests, but also tend to prefer natural over urban environments in leisure travel. They tend to dislike suburban residential environments, but value access to natural environments close to home. Compared to the other groups they are somewhat more likely to be men, single (31%), and speak Polish (7%).

Table 12. Average factor scores based on attitudes and preferences in the mobility style clusters

	Variables	Concerned pro-density urbanites	Pro-car suburbanites	Unconcerned pro-car urbanites	Anti-car environmentalists	Unconcerned suburbanites	Cosmopolitan urbanites
Average scores of attitudinal factors	Pro-environmental attitude	0.27	-0.12	-0.34	0.83	-0.45	0.05
	Climate change awareness	0.23	0.31	-0.36	0.17	-0.29	0.00
	Cosmopolitan attitude in travel	0.18	-0.17	0.03	-0.03	-0.22	0.48
	Preference for urban vs. natural settings in travel	0.92	-0.37	0.60	-0.09	0.08	-0.37
	Suburban preference	-1.27	0.65	-0.96	-0.09	0.55	-0.44
	Pro-car attitude	0.16	0.37	0.80	-1.00	0.11	-0.22
	Preference for shared housing and transport	0.34	0.06	-0.17	0.11	0.03	-0.20
	Preference for nature and privacy	-0.43	0.36	-0.38	-0.06	-0.33	0.65
	Number of members	54	135	55	94	117	70

Note: Positive factor scores (green) represent a value higher than average and negative ones (red) below average. A score of 0 is average. The more the factor score deviates from 0 the stronger the difference is in preference or attitude.

The attitude-based segments show a strong degree of geographical clustering. The *concerned pro-density urbanites* tend to live close (ca 2.3 km, on average) to the main city center. The majority (76%) of them lives in the central pedestrian zone or its fringe. The *anti-car environmentalists* live somewhat farther from the city center (average 4.2 km). Many of them (56%) live in the central pedestrian zone or its fringe, but a considerable proportion of them (26%) lives in the car-oriented zone. The *cosmopolitan urbanites* have a similar geographical distribution to that of the previous group: they live relatively close to the city center (ca 5 km), and many of them (51%) live in the central pedestrian zone or its fringe. The geographical distribution of the *unconcerned pro-car urbanites* is close to average, with a slight tendency to live in areas with good access to public transportation (13%) and close to the sub-centers (11%). Members of the remaining (and the most populous) segments tend to live much farther from the city centers, in line with their residential and travel mode preferences. The *unconcerned suburbanites* are likely to live in the car-oriented zone (40%) and the basic public transportation zone (22%). They live, on average, 7.8 km from the city center. The *pro-car suburbanites* are the most likely to live in the car-oriented zone (51%) and the basic public transportation zone (26%). They live the farthest from the city center, 8.4 km on average.

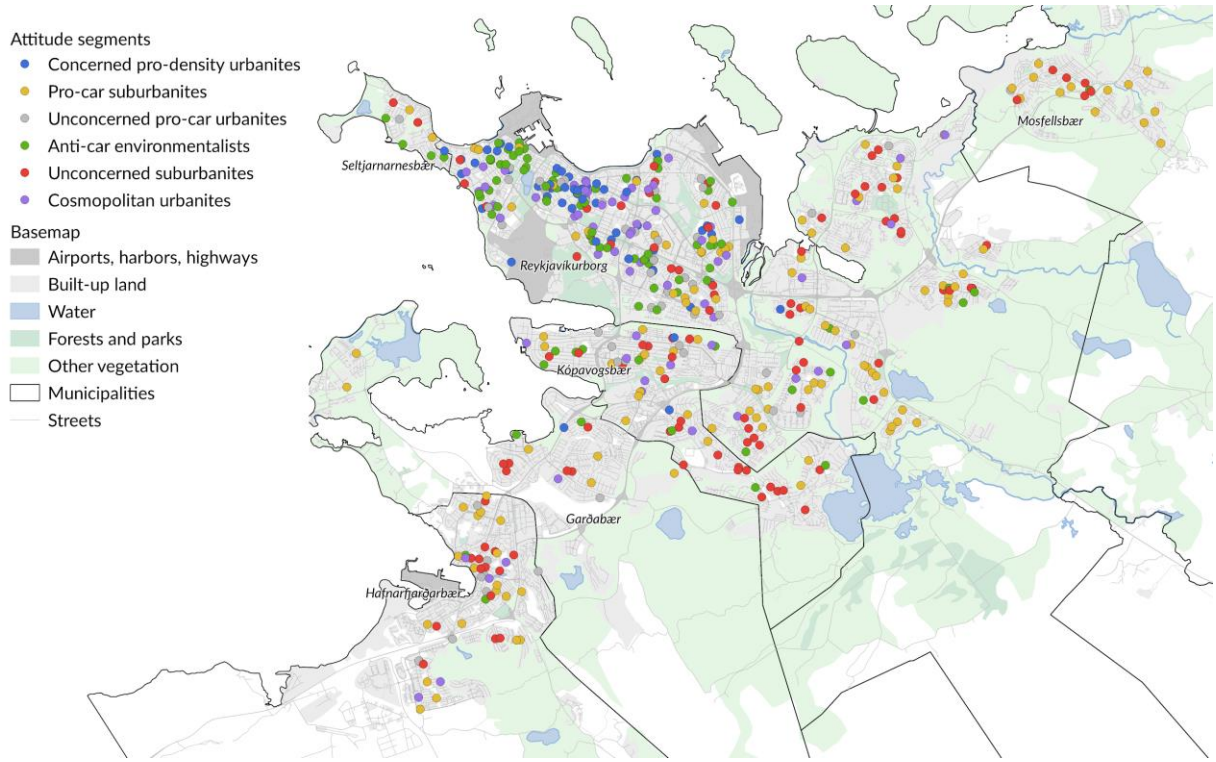

Figure 10. Geographical distribution of members of the attitude-based segments (i.e. mobility styles)

Table 13. The distribution of the members of the attitude-based mobility style in travel-based urban zones.

Clusters		Travel-related urban zones							
No	Name	Central pedestrian zone	Fringe of the central pedestrian zone	Intensive public transportation zone	Pedestrian zones of the sub-centers	Basic public transportation zone	Car-oriented zone	Average distance to the city center	N
1	Concerned pro-density urbanites	41%	35%	4%	4%	7%	9%	2.27	54
2	Pro-car suburbanites	3%	10%	1%	9%	26%	51%	8.43	135
3	Unconcerned pro-car urbanites	16%	24%	13%	11%	16%	20%	5.25	55
4	Anti-car environmentalists	22%	34%	5%	4%	9%	26%	4.21	94
5	Unconcerned suburbanites	6%	15%	4%	12%	22%	40%	7.78	117
6	Cosmopolitan urbanites	20%	31%	3%	7%	13%	26%	4.98	70
	Summary	15%	22%	4%	8%	17%	33%	6.10	525

Table 14. Socio-demographic characteristics of members of the attitude-based mobility styles

Variables		Concerned pro-density urbanites	Pro-car suburbanites	Unconcerned pro-car urbanites	Anti-car environmentalists	Unconcerned suburbanites	Cosmopolitan urbanites	Sample
Gender	Female	57%	63%	44%	65%	59%	46%	58%
	Male	41%	36%	56%	33%	40%	54%	42%
Employment status	Employed full time	61%	70%	69%	70%	69%	71%	69%
	Employed part time	6%	7%	9%	7%	3%	9%	7%
	Self-employed/Entrepreneur	7%	4%	2%	5%	9%	1%	5%
	Stay-at-home-parent/ Paternity or maternity leave	6%	4%	0%	2%	7%	4%	4%
	Student	15%	10%	13%	9%	8%	9%	10%
	Unable to work	2%	4%	4%	4%	2%	1%	3%
	Unemployed	4%	0%	2%	1%	2%	0%	1%
	Other	0%	1%	2%	1%	1%	4%	1%
Education level	Basic education	7%	8%	13%	3%	5%	10%	7%
	Vocational education	9%	8%	9%	4%	7%	12%	8%
	Secondary education	17%	15%	18%	9%	17%	21%	16%
	Undergraduate level	35%	33%	31%	38%	36%	22%	33%
	Graduate level	30%	34%	27%	34%	28%	31%	31%
	Postgraduate level	2%	2%	2%	11%	7%	3%	5%
Household type	Couple with child/children	32%	53%	53%	61%	43%	46%	51%
	Couple living together	26%	25%	9%	23%	22%	17%	21%
	Single person without children	38%	15%	24%	12%	25%	31%	20%
	Single parent with child/children	0%	6%	7%	2%	5%	2%	4%
	Other	4%	2%	7%	2%	6%	4%	3%
Monthly income per consumption unit	Very low (below 290k kr)	22%	11%	47%	13%	21%	11%	17%
	Low (290k to 390k kr)	43%	16%	20%	21%	18%	24%	21%
	Medium (390k to 510k kr)	15%	31%	14%	28%	30%	22%	26%
	High (510k to 670k kr)	11%	26%	14%	21%	16%	22%	21%
	Very high (above 670k kr)	9%	16%	4%	16%	15%	20%	15%
Survey language	Icelandic	93%	82%	84%	81%	84%	80%	83%
	English	7%	13%	15%	18%	13%	13%	14%
	Polish	0%	4%	2%	1%	3%	7%	3%

3.3 Attitudes vs. travel behaviors

This section compares how much do travel-related attitudes and preferences align with travel behaviors. Similar previous research suggests that the alignment is seldom complete, but that attitudes and preferences influence behaviors to a certain extent (Prillwitz & Barr, 2011).

Results

In our sample, *bus commuters* tend to be more concerned than other groups about environmental impacts and more willing to live ecologically. They tend to prefer urban environments in leisure travel and dislike car as a daily travel mode. They have a diverse membership in the attitude-based segments and are the most likely to belong to the *anti-car environmentalists* (23%), *unconcerned suburbanites* (21%), and *concerned pro-density urbanites* (17%).

The *consistent car commuters* tend to have somewhat weaker pro-environmental attitudes than other groups, even though they are aware of climate change. They have a strong preference for using cars in daily travel. They are most likely to belong to the pro-car suburbanites (34%) and the *unconcerned suburbanites* (26%).

The *multi-modal car commuters* differ from the *consistent car commuters* in that their preference for cars is average. In turn, they do not mind sharing their housing environments or trips with others, as much as the other groups do. Their membership in attitude-based segments is similar to that of the whole sample and they are most likely to belong to *pro-car suburbanites* (25%), and *unconcerned suburbanites* (23%).

The *non-commuters* are more concerned than other groups about general environmental impacts but are somewhat less concerned about climate change. They rather do not seek novelty or diversity in their leisure travel (i.e. don’t have cosmopolitan attitudes). They dislike sharing their housing or trips with others, in turn opting for residential environments that are suburban, secluded, and close to nature. They are most likely to belong to the *pro-car suburbanites* (31%) and the *unconcerned suburbanites* (29%).

The *pedestrian commuters* dislike car as a daily travel mode and suburbs, but they like closeness to nature in residential environments, as well as on leisure trips. On average, they are not much in favor of sharing their housing environments or trips with others. They are most likely to belong to the *anti-car environmentalists* (28%), the *cosmopolitan urbanites* (22%), and the *concerned pro-density urbanites* (14%).

The *bicycle commuters* very strongly dislike cars as a daily travel mode. They tend to be concerned and aware of climate change and have a slightly stronger preference for urban rather than natural environments in leisure and residential context alike. They are most likely to belong to the *anti-car environmentalists* (40%), and the *concerned pro-density urbanites* (19%).

Table 15. Average attitude factors scores in behavior-based modality styles

	Variables	Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters
Average scores of attitudinal factors	Pro-environmental attitude	0.31	-0.18	0.31	0.06	-0.07	0.11
	Climate change awareness	-0.09	0.08	-0.17	0.10	0.11	0.17
	Cosmopolitan attitude in travel	0.03	0.02	-0.33	0.07	0.07	-0.07
	Preference for urban vs. natural environments in travel	0.35	0.00	-0.10	-0.02	-0.11	0.10
	Suburban preference	-0.03	-0.01	0.20	0.05	-0.32	-0.06
	Pro-car attitude	-0.42	0.52	-0.12	0.02	-0.53	-0.95
	Preference for shared housing and transport	-0.01	0.04	-0.20	0.23	-0.16	-0.07
	Preference for nature and privacy in residential environment	-0.12	-0.06	0.25	-0.06	0.25	-0.15

Note: Positive factor scores (green) represent a value higher than average and negative ones (red) below average. A score of 0 is average. The more the factor score deviates from 0 the stronger the difference is in preference or attitude.

Table 16. Alignment between behavior-based modality styles and attitude-based mobility styles

Clusters	Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	Summary
Concerned pro-density urbanites	17%	7%	7%	10%	14%	19%	10%
Pro-car suburbanites	17%	34%	31%	25%	15%	10%	26%
Unconcerned pro-car urbanites	9%	13%	9%	9%	11%	8%	11%
Anti-car environmentalists	23%	8%	21%	18%	28%	40%	18%
Unconcerned suburbanites	21%	26%	29%	23%	11%	15%	22%
Cosmopolitan urbanites	13%	13%	3%	15%	22%	8%	13%
Summary	100%	100%	100%	100%	100%	100%	100%

Because of the imperfect alignment between attitudes and behaviors, the differences in travel-related GHG emission levels between the attitude-based segments are not as strong as they are between the *modality styles* (see Figure 5 and Figure 11).

The group with the highest amount of GHG emissions from travel are the *cosmopolitan urbanites*, who take many leisure and business trips abroad. Their emissions amount to **6.7 tCO2e** per year per person. Even though they have a relatively high share of trips made on foot (20% commuting and 37% non-commuting trips), they predominantly move around by cars (59% commuting and 51% non-commuting trips). Resulting GHG emissions from local travel amount to **1.2 tCO2e** per year per person. They take a high number of leisure trips abroad (2.6 per year), and many business trips (1.3 per year), and have high GHG emissions from travel abroad (**5.6 tCO2** per year per person). They also travel much within Iceland. On average, they make 10.3 leisure and 3.1 business trips domestically, and their emissions from these trips are estimated at **0.7 tCO2** per year per person.

Unexpectedly, the group with the lowest estimated level of emission are the *unconcerned pro-car urbanites*. Their total travel-related emissions amount to **5.4 tCO2e** per year per person. Even though the majority of their local trips are made by cars (65% commuting and 64% non-commuting trips), they travel shorter distances within the city than do the other groups (4.4 thousand km compared to 5.5 thousand on average) and their local travel emissions amount to around **1 tCO2e** per year. They take many leisure trips abroad (3 trips per year), but relatively few business trips (0.5 trips per year). Their international trips are also shorter on average and, as a result, their yearly emissions from travel abroad are estimated at **3.9 tCO2e**.

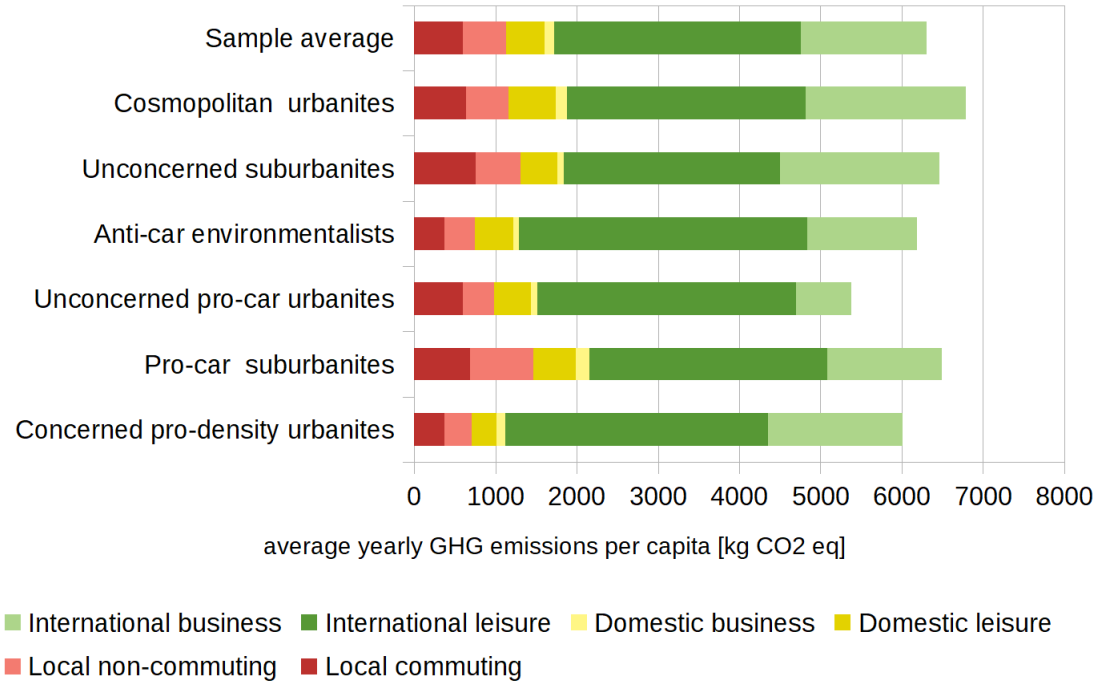

Figure 11. Yearly average travel-related GHG emissions per member of the attitude-based mobility styles

Table 17. A summary of local travel patterns (i.e. made within the Reykjavik Capital Region) of the members of the attitude-based mobility styles

Variables		Concerned pro-density urbanites	Pro-car suburbanites	Unconcerned pro-car urbanites	Anti-car environmentalists	Unconcerned suburbanites	Cosmopolitan urbanites	Sample
Commuting trips mode share	Car	39%	65%	65%	34%	61%	59%	55%
	Bus	18%	7%	6%	15%	11%	10%	11%
	Foot	20%	8%	13%	20%	8%	20%	14%
	Bicycle	15%	6%	7%	19%	6%	8%	9%
Non-commuting trips mode share	Car	45%	73%	64%	37%	64%	51%	58%
	Bus	5%	2%	5%	7%	2%	3%	4%
	Foot	39%	20%	19%	43%	26%	37%	30%
	Bicycle	9%	3%	3%	12%	3%	7%	6%
Cars in the household	None	22%	4%	7%	24%	7%	14%	12%
	One	59%	49%	53%	57%	53%	63%	55%
	Two	17%	41%	31%	15%	35%	20%	29%
	More than two	2%	7%	9%	3%	5%	3%	5%
Average yearly distances traveled with travel modes	Car	2804	5896	4059	2556	5220	4682	4475
	Bus	719	321	180	1067	489	402	529
	Foot	433	475	190	513	320	404	403
	Bicycle	151	104	52	246	100	148	134
	Total	4107	6796	4481	4382	6129	5636	5541
Average GHG emissions from local travel	Car	601	1426	961	599	1244	1101	939
	Bus	104	46	26	154	70	58	64
	Commuting trips	370	687	603	373	763	644	563
	Non-commuting trips	334	785	384	380	551	515	440
	All trips	705	1473	987	752	1315	1159	1003
Share of different types of activities in local trips	Work- or study place	38%	34%	44%	34%	38%	43%	38%
	Shopping	17%	20%	17%	16%	16%	17%	17%
	Services and errands	5%	5%	5%	6%	4%	4%	5%
	Daycare, kindergarten, school or after-school activities	16%	18%	9%	16%	20%	15%	16%
	Culture and sports events	2%	3%	1%	4%	4%	2%	3%
	Leisure and going out	9%	3%	7%	6%	4%	5%	5%
	Sport and active recreation	11%	15%	14%	15%	11%	12%	13%
	Other	2%	3%	2%	3%	2%	2%	2%

Table 18. A summary of long-distance travel patterns (i.e. made away from the Reykjavik City Region, domestically and internationally) of the members of the attitude-based mobility styles.

Variables		Concerned pro-density urbanites	Pro-car suburbanites	Unconcerned pro-car urbanites	Anti-car environmentalists	Unconcerned suburbanites	Cosmopolitan urbanites	Sample
Average GHG emissions from long-distance travel	Domestic leisure trips	308	514	455	471	445	583	308
	Domestic business trips	116	173	79	69	87	137	116
	Domestic trips	423	687	534	540	532	720	423
	International leisure trips	3223	2926	3182	3543	2657	2944	3223
	International business trips	1655	1403	676	1354	1956	1968	1655
	International trips	4878	4329	3858	4897	4613	4912	4878
	All leisure trips	3531	3440	3636	4014	3102	3527	3531
	All business trips	1771	1576	755	1423	2044	2105	1771
	All long-distance trips	5302	5016	4392	5437	5145	5632	5302
Average number of long-distance trips	Domestic leisure trips	7.39	10.81	8.65	9.51	10.02	10.26	9.75
	Domestic business trips	3.93	2.93	2.02	1.39	1.79	3.12	2.43
	International leisure trips	2.74	2.10	3.00	2.15	1.75	2.60	2.26
	International business trips	1.15	0.99	0.47	0.88	1.17	1.34	1.02
Travel mode shares in domestic trips	Car	87%	89%	81%	87%	90%	83%	87%
	Plane	4%	6%	5%	4%	5%	7%	5%
	Bus	6%	4%	10%	7%	2%	8%	5%
	Boat	2%	2%	4%	2%	3%	2%	3%

4 Mobility styles and subjective well-being

Background

Long commutes from suburban neighborhoods have been associated with less time spent at homes and residential areas, thus negatively influencing life satisfaction and relationships among families (Stutzer and Frey, 2008) and local communities (Putnam, 2000). Commuting negatively affects people's current mood (Kahneman et al., 2004), particularly by car or bus, while walking and cycling are associated with positive mood (Gaterslebem & Uzzell, 2007; Morris & Guerra, 2014) and health improvements (Pucher et al., 2010, de Hartog et al., 2010).

Researchers have also suggested that shape, size, and content of activity spaces might be related to well-being. For instance, a number of unique visited locations may be an indication of social involvement (Schönfelder & Axhausen, 2003). On one hand, small or "austere" activity spaces may be an indicator of social exclusion, and might signify being "trapped in a neighborhood". The risk of such travel-related social exclusion may be higher among certain social groups, such as older adults, people with disabilities, single parents, and disadvantaged immigrants (Kenyon et al., 2002; Meng, 2004). It is more likely to be acute in societies and urban structures that are highly car-dependent (Mattioli, 2014). On the other hand, small activity spaces may also be a result of choice or being able to find apt resources and opportunities without traveling far. Several studies have shown that residents of centrally-located and densely-built areas have smaller and less dispersed activity spaces than residents of suburbs or rural areas (Flamm & Kaufmann, 2006; Manaugh & El-Geneidy, 2012). These characteristics are thought to be associated with the higher use of active travel modes, better health (Manaugh & El-Geneidy, 2012), and are expected outcomes of walkable neighborhoods (Talen and Koschinsky, 2013).

The effects of daily mobility on well-being are likely modified by personal preferences or mobility styles. For instance, a positive or negative outlook on a specific travel mode may modify its positive or negative impacts on well-being. The dissonance between travel-related preferences and residential neighborhood may cause dissatisfaction, e.g. among people who would prefer walking to work, but their non-central and more affordable residence only allows car or bus commuting. Such interdependencies are relevant for residential choices, travel behaviors, and may potentially influence planning policies related to transportation, housing, and land use.

4.1 Modality styles and subjective well-being

Comparing the connections between the primary commuting travel mode and satisfaction with life domains, it was found that those commuting by bus had the lowest satisfaction levels, whereas those traveling with bicycle, car or by foot shared relatively equal satisfaction levels. This implies that bus commuting is less a choice made by will, but more due to a feeling of no other option being available or serving well. Those primarily commuting by foot were found to have the highest life satisfaction as a whole. Interestingly, those using cars reported the lowest satisfaction with the amount of time to do things they would like to do. Bicycle commuters were found to have the highest satisfaction with their state of health.

Clear differences were found between the mobility style groups on their stated subjective well-being. Car commuters (consistent and multi-modal) reported the highest levels of satisfaction, whereas bus commuters and non-commuters reported the lowest. This implies that bus commuting and non-commuting are fewer choices made by will, but more a life course situation (non-commuting) or due to the feeling of no other option being available or serving well (bus commuting). Those primarily commuting by foot were found to have the highest life satisfaction as a whole.

Table 19. Average scores of satisfaction with life domains among members of the behavior-based modality styles

How satisfied are you with...	Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	Summary
...your material standard of living?	6.12	6.98	6.20	7.03	6.64	7.00	6.77
...your current state of health?	6.77	7.06	6.35	7.08	7.08	7.66	6.99
...your personal relationships?	6.98	7.77	7.19	7.69	7.62	7.82	7.59
...feeling part of your community?	6.23	7.00	5.90	7.37	6.97	6.80	6.83
...the amount of time you have to do the things you like doing?	6.03	5.76	6.08	6.22	6.46	6.28	6.05
...your main occupation such as job or studies?	6.83	7.11	6.34	7.47	7.60	7.08	7.11
...the quality of your local environment?	6.90	7.31	7.09	7.61	7.19	7.43	7.30
...things you are achieving in life?	6.75	7.00	6.33	7.12	7.01	7.00	6.91
...how safe you feel?	7.63	7.95	7.49	7.95	7.89	8.13	7.87
...your life as a whole these days?	6.77	7.40	6.87	7.55	7.62	7.38	7.33

Note: Satisfaction scores in green represent a value higher than average and scores in red below average.

One of the lowest scores was found within the group “consistent car commuters” with satisfaction with the amount of time they had to do the things they like doing. This indicates that either they are stuck in traffic for too much time, or that they drive between places rather than take other travel modes because of time constraints in life. However, the score for this satisfaction question was relatively low with all types of commuters. In the interviews, those who drove to work and lived in suburbs were generally less satisfied with the time they spend traveling than those who took other travel modes, but those that drove to work and lived centrally were generally satisfied as it took less time, either due to the location of their job being close or the traffic on the way was less.

Non-commuters had a low score for satisfaction with feeling part of their community. They also had the lowest scores compared to other groups with satisfaction with how safe they feel, things they are achieving in life, their main occupation and their current state of health. This group generally has a small activity space, stressing the importance of more research into activity spaces and well-being of Reykjavík residents.

The score that was the highest compared to the average was the satisfaction with the current state of health, where bicycle commuters had .67 higher than average. This might be an

indication of a positive effect the cycling has on physical and mental health that have been well documented in previous studies (e.g. de Hartog et al., 2010), but may also be due to the able-bodied residents being more likely to start cycling in the first place. In the interviews, those that cycled a lot expressed a feeling of accomplishment and reported that their commute had a positive effect on both mental and physical health.

Adding the total scores from all satisfaction categories revealed that non-commuters had the lowest total satisfaction scores, closely followed by bus commuters. The highest total score was found with multimodal car commuters, followed by bicycle commuters. Pedestrian commuters had a slightly higher total score than consistent car commuters.

Table 20. Average scores of satisfaction with life domains among the members of the attitude-based mobility styles

How satisfied are you with...	Concerned pro-density urbanites	Pro-car suburbanites	Unconcerned pro-car urbanites	Anti-car environmentalists	Unconcerned suburbanites	Cosmopolitan urbanites	Summary
...your material standard of living?	6.92	6.59	6.51	6.61	7.34	6.91	**6.83**
...your current state of health?	7.23	6.90	6.67	7.28	7.09	6.99	**7.03**
...your personal relationships?	7.66	7.73	6.91	7.85	7.99	7.29	**7.66**
...feeling part of your community?	7.09	6.88	6.53	6.71	7.04	6.42	**6.81**
...the amount of time you have to do the things you like doing?	6.58	5.75	5.96	6.34	6.07	5.57	**6.01**
...your main occupation such as job or studies?	7.06	7.21	6.87	6.78	7.53	7.16	**7.15**
...the quality of your local environment?	7.19	7.61	6.75	7.09	7.50	6.97	**7.27**
...things you are achieving in life?	6.90	7.02	6.24	6.76	7.36	7.19	**6.98**
...how safe you feel?	8.11	7.82	7.20	8.15	8.09	7.79	**7.90**
...your life as a whole these days?	7.62	7.21	7.13	7.18	7.72	7.30	**7.36**

Note: Satisfaction scores in green represent a value higher than average and scores in red below average.

The group that had the highest satisfaction with the quality of their local environment were the Unconcerned suburbanites, who reported higher-than-average satisfaction in all the domains. The lowest score on satisfaction with the quality of their local environment was found with the Unconcerned pro-car urbanites. They were also the only group with only below average scores in all satisfaction categories. Relatively unsatisfied were also the Anti-car environmentalists, whom however reported the highest satisfaction with their state of health.

5 Qualitative data analysis

Theme 1. Residential choices

Choosing an appropriate residential location was very important to all interviewees a the rate of residential self-selection was very high in our sample. It was common that people chose places they grew up in so they knew the location well before deciding to live there. However, in some cases respondents reported that the selection of neighborhood was based on their spouse having lived there before, for example: *"my wife was raised in Vesturbær, and she spoke well of it"*. In some cases, the selection was limited by housing affordability and availability. Participants mentioned a desire to live close to family members, but none mentioned proximity to friends as an important aspect when choosing a residential location, but rather mentioned it as a positive coincidental quality.

Suburban dwellers often put a value on walkability, access to services and social aspects of their neighborhoods which are qualities usually connected to centrality. However, they mentioned walkability mainly for their children, but they themselves didn't mind driving to the grocery store as long as it was not too far. It was common that respondents wanted to live away from traffic, even those who preferred a central dense environment. This aspect was also important to parents: *"There are very few heavy traffic streets, which is good for the children. The main fast traffic veins are around Seltjarnarnes, but everything inside it is pretty safe"*. Two respondents who recently moved from suburbs to the center reported annoyance with not finding a parking space when first moving in, but both had gotten used to it and it didn't bother them anymore. In addition, one interviewee said that walking distances became mentally shorter when living in the center, compared to the suburbs.

Theme 2. Urban form and subjective well-being

It seemed important to some interviewees that their neighborhood is lived-in, meaning that there are signs of previous generations of residents and a rich history: *"Many people have lived here for decades. People stay in the neighborhood and aren't looking to move away"*, and with other respondents meaning homely and lively, a place with many activities around rather than like a *"sterile institution"* were people only go to sleep. Similarly, good walkability and good cycle paths had a positive effect on well-being.

The greenness of the neighborhood was important to some and not to others. Although not everyone stressed the importance of trees and greenery on their street, most found it important to have nature, public gardens or the sea in close proximity to their homes, with some reporting a sense of zen, calmness, and relaxation from utilizing green areas. One respondent said: *"There are many things [about my residential location] that make me feel good, it's a short walk down to the ocean to see the view from there."*, *"It's very comfortable to walk along the coast when you want to go for a walk"*. All respondents with children mentioned that good access to open and green areas was an important neighborhood quality for their children.

Urban form seemed to influence social aspects of well-being but in quite different ways. One respondent who lived in a mobile home in the outskirts of Reykjavík reported the will to move to a small town in the countryside in order to feel like a part of a community, while a few other central dwellers viewed the city center as a hub for social interactions. Some

suburban residents socialize a lot within the neighborhood, inviting friends and family to their home or visiting others at their homes.

Having services around or activities to choose from was a common answer to the question of how their neighborhood affected their well-being. One reported: *"Having services around just makes you feel good, you feel good just knowing that for example when it's gay pride and you can just walk out the door without having to deal with the hassle of getting there. You "fall into" concerts when you're walking around downtown."* Another said: *"There are many things that make me feel good in the neighborhood, there good schools and a strong sports club, there's everything you need there."*

Theme 3. Daily travel and subjective well-being.

Suburban dwellers reported negative effects on well-being having to commute via private car due to the stress of traffic. An example of this was an interviewee who was forced to drive a lot due to many job locations a day: *"there's nothing that irritates me more than traffic"*. Central residents commuting to suburbs did not mind their trips because there is not much traffic going in that direction. Car commuters enjoy being shielded from the weather. One central dweller who seldom drove to work said that *"although it's very comfortable to be able to get out of the weather and into a car, the feeling is all in your head and when you're already out in the weather it's fine"*.

Those who walk or cycle to work generally enjoy the trips are able to zone out and sometimes even feel a sense of accomplishment, while the negative aspects of these commutes were generally caused by private car traffic around them or bad weather.

Bus commuters enjoy being able to relax on the way, listen to music or a podcast, and some even take a nap. Other interviewees pointed out to the additional utility of taking buses related to being able to work or read on the commute (e.g. prepare for a meeting, do the homework, read a book). One said: *"My friend is able to arrive at work half an hour later than others and leave half an hour earlier because she works on the bus"*. For one interviewee, buses were a *"mobile social space"*, as she put it, in which it's possible to interact with people from diverse backgrounds.

One suburban resident had recently quit her job as the morning traffic was *"killing her"*. She reported that her life had changed for the better with less stress and relieved pressure of daily life running home with kids. Another said that changing jobs, buying a car and having to drive to work rather than take the bus changed his life for the worse.

Theme 4. Urban form and long-distance travel

One of the potential explanations of the higher frequency of international travel among central urban dwellers is a travel cost rebound effect, in which lower level of car ownership and use allows for increased expenditures on other goods and services, such as holiday travel (Ottelin et al., 2014, 2017). Such an effect was not clearly apparent in our qualitative results, partly because only two respondents from our first phase of interviews didn't own a car. One of those two individuals took 17 flights in the last year, which was more than any other participant. She did not mention specifically that she does not own a car to save money for travel, it was more of a lifestyle choice, but saving money for travel was very important to her

in general. The other participant who didn't have a car traveled as much as she had time for, so although her expenditure on goods and services was high and she wasn't much for saving money if she did save she wouldn't anyway have time to travel more than she does. Another respondent, who lives centrally but owns a car, stated that her central location of residence makes her spend more money on restaurants and merchandise from shops because the services are right there in front of her, but she spent less on *"fuel and everything like that"*. When she lived in Hafnarfjörður she reported: *"I couldn't be bothered to go anywhere because I had to for example drive to Smáralind to do something"*. Money spent on renovations is taken away from the travel fund, mentioned by three participants. Many respondents mention saving their money for travel, for instance by spending less on commercial products or food.

Another potential reason for central dwellers traveling more abroad is related to the compensation hypothesis, in which the residents of densely populated urban areas tend to compensate for the lack of open space, green areas, and recreational opportunities by taking longer and more distant holiday or weekend trips. No respondents mentioned similar reasons directly, but we did find a potential link with domestic travel. One respondent stated that after moving from Hafnarfjörður to Miðbær, she goes on longer trips outside of Reykjavík in order to spend time in nature. Before she used to utilize the natural areas and mountains just outside of Hafnarfjörður, but now she visits the cabin more frequently instead. Another respondent living near the outskirts of Reykjavík said that she doesn't need to travel as much to the rural areas now because of her current location near nature and said she might have traveled more outside the city if she lived in the city center. However, one respondent living in 101 mentioned quite a different perspective: *"Some of my friends feel the need to get away from their daily routine and relax by going to the countryside, but if I ever feel like that then it's usually enough for me to walk down to the seashore, I usually get some kind of zen feeling or something like that"*.

Those who share a garden with others did not utilize it as much as those who have a private yard. Respondents often said that they preferred leisure trips to places where there are not many other people or places that are different from where others usually go. In the quantitative data, those who owned a private yard had, on average, lower emissions from both national and international travel, which could indicate that private yards somewhat fulfill the need to travel away from others or spend time alone in nature.

However, this issue is dependant on individual preferences and the differences could sometimes be reflected in the choice of residential location. An example of this is one respondent who preferred a dense residential environment had a preference of traveling to cities rather than to natural environments, to *"do the same things as at home"*, *"experience something new, something bigger, with more people and more choices to do whatever"*. Another respondent who valued privacy greatly when choosing her neighborhood also mentioned traveling away to get away from people, *"...it's really important to me to have privacy, and this house just ticked all the boxes."*, *"[talking about the garden]...which I think is a very good advantage, having that privacy, not too close to other residents."*, *"[mixed land use] really takes away the privacy of the people."*, when asked if there was anything about her home or residential area that makes her want to travel more often outside the city. she replied: *"No, or just get away from people like always."*.

Motivations for traveling abroad were many and diverse. One of the reasons that stood out from the interviews was learning about cultures and people. For example, traveling "*broadens*

the world view. It's amazing what you can learn in a couple of days abroad", and "*broadens your thinking, you learn about the culture, it minimizes racism... makes your world view more clear*". One mentioned that "*the world offers a richer culture than Iceland does*".

Experiencing new and different things was an apparent reason for travel with our interviewees, as it for example "*gives life color*". They wanted to experience something different, go out of their norm, explore and visit "*once in a lifetime places*", experience new exotic places and seek adventure, see something they haven't seen before and heard a different language. Having more options and diversity in activities was mentioned by a few, one reporting that "*you get more from trips where there's more to do, where there's more of an experience*".

Social aspects of traveling were important to the majority of the sample, either to meet new people: "*to get to learn about the people in depth*", to visit friends and family living abroad or to spend quality time with people by travelling somewhere together, for example: **"***I went with a big group of friends, it was kind of like a reunion for us, very healthy, to strengthen bonds with old friends*". One mother said that she travels to certain destinations to do something fun for her kids, while she herself would rather go on different kinds of trips with friends.

Creating memories was a popular reason for traveling. Trips create memories "*to look back on, give experiences that you can utilize*", and "*you acquire beautiful things that make you experience your trips again, give you happiness afterward*".

Social media may in some cases motivate travel, but in most cases, interviewees were reporting why they think others travel, not why they themselves travel. One, however, said she got ideas on destinations from others, or by reading about them. Despite them not reporting that social media influenced their own travel, other people's' opinions and travels seemed to matter: "*I look for something weird that others haven't seen, that is not the norm with everyone*.", "*My dream trip would be to go to a new exotic place, where not a lot of people go, which is not popular, so other people would go "what? You went there!?"* and "*It deters me away from places if a lot of others have also been there, it's not as exciting*".

While some expressed the need to get away from Reykjavík as "*we live on an island in the middle of the ocean*", others had a different opinion: "*I travel less now abroad after I moved to Reykjavík [from Norway], I've lost interest in it as I just love it here*". Another said that she didn't feel the need to travel away like other Icelanders, but she lets places drag her to them rather than going because something is pushing her away. Others talked about the freedom of traveling and freedom from thinking about work. Traveling for relaxation was only apparent with some, but traveling for better weather was mentioned often, for example: "*I had enough of the bad weather last summer, I'd been waiting for the great summer in Iceland for a few years, it's one of the reasons for buying the apartment in Spain. Weather is a big reason for going on sun holidays*". Some mentioned that traveling was good for mental health, "*fills an emotional tank, if you've been for a long time stuck at home*", gives fulfillment and you feel refreshed.

6 Conclusions

The project was set to address three research goals:

1. identify distinct mobility styles among Reykjavik young adults based on their travel patterns, residential location, and related preferences
2. investigate relationships between the mobility styles, and two facets of urban sustainability: subjective well-being, and greenhouse gas (GHG) emissions
3. explain causal mechanisms and elicit personal rationales behind observed associations between mobility styles, residential choices, urban form, and well-being.

The reports main results were related to segmentation, modality styles, attitudes, and well-being.

First, the respondents were grouped based on their use of travel modes in local travel (i.e. *modality styles*), and then they were also assigned a group based on their attitudes and preferences related to residential location, travel mode choice, leisure destinations and pro-environmental attitudes (i.e. *mobility styles*). These two groupings were then utilized in the further analysis.

Trip distances and frequencies and greenhouse gas emissions were calculated and the Reykjavík Capital Region was split into travel-related urban zones. The groups of different modality styles were then compared by residential location and urban zones and plotted on maps. They were then compared based on their climate impact.

Spatial clustering of the groups of attitudinal factor scores was shown in tables and maps, then the segmentation of the study participants based on their attitudes and preferences was presented. The climate impact of the attitude related groups was then compared, along with the percentage of participants of each modality style in each attitude related group.

Subjective well-being was measured in satisfaction with various aspects of life, and compared between both the modality style and attitude related groups.

Finally, the qualitative analysis is presented from each of the four themes of the project.

Next steps

The SuReCaRe 2 project, presented in this report, took some important steps in improving our understanding of the premises of urban sustainability. The SuReCaRe project will continue to phase 3 in 2019, and expands the perspectives reported here three objectives:

1. To characterize mobility styles of Reykjavik residents at the aggregate spatial levels based on individual travel patterns and residential locations
2. To provide detailed knowledge about motivations and rationales behind daily travel behavior and its associated factors such as car ownership and residential location
3. To explore the daily travel patterns and urban form at the residential location on subjective well-being.

Taking these steps will help to inform spatial planning and transport policies in the Reykjavik Capital Region by identifying the regions with specific needs and potentials for a behavioral

change, informing planning with insights on the factors that drive behavioral choices and change, and by providing a broader sustainability perspective and background knowledge for motivating behavioral change.

Höfundar skýrslunnar bera ábyrgð á innihaldi hennar. Niðurstöður hennar ber ekki að túlka sem yfirlýsta stefnu Vegagerðarinnar eða álit þeirra stofnana eða fyrirtækja sem höfundar starfa hjá.

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