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Article

Towards Carbon-Neutral Mobility in Finland: Mobility and Life Satisfaction in Day-to-Day Life

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Abstract: Finland, a prosperous Nordic country with a population of 5.5 million and significant distances between towns, though quite short distances traveled by car, is aiming to be a carbon-neutral society by 2035. Due to the level of urgency, a technological pathway with decarbonization of fuels and innovation only, is unlikely to be sufficient. Instead, a more systemic change based on a transformative pathway with demand-side management, i.e., measures based on behavioral change, is vital. In this research we were interested in learning how life satisfaction relates to the behavioral intentions of Finnish citizens, regarding a sustainable modal shift. We focused on walking, cycling, public transport and reduction in car use, e.g., a transition from fossil fuels to active mobility, from ownership to usership. Data were collected via a questionnaire in April 2017. The respondents (n = 2052) provided 2335 comments as to why they considered a specific sustainable modality as being important to them. We applied both qualitative and quantitative methods in order to establish how the mobility behavior of citizens manifests nationwide and the types of arguments that citizens put forward concerning their mobility intentions. The results indicate that there is a strong relationship between the respondents' reduced use of private cars and their life satisfaction. There is a concern about sustainability and a willingness to change current mobility practices, as well as signs of altruism, while hedonic concerns such as health and personal finances dominate the responses. Furthermore, concerns about social injustice, such as a lack of public transport, are emerging themes, i.e., when enacting mobility transitions it is vital to focus on how to enable a meaningful life for all demographic groups using suitable mobility services.

Keywords: sustainable mobility; demand management; life satisfaction; sustainability transitions; mobility behavior; cycling; walking; car use; public transport

1. Introduction

The transport sector is responsible for one third of global energy consumption and the volume of emissions is growing rapidly. If climate change is to remain below 2 °C, the percentage of current fossil fuel reserves that should have been taken out of use by 2050 are: coal 82%, gas 49% and oil 33% [1]. Automobility is the dominant system of mobility for privatized and motorized mobility [2,3] and for sustaining a significant carbon lock-in [4]. Practices of car culture [5] that are supported by policy, technology and infrastructure [6] pose a major challenge to both low-carbon mobility transition

and social welfare [7]. For instance, within the European Union the annual cost of automobility is around €500 billion, whereas cycling and walking provide savings worth €24 billion and €66 billion, respectively [7].

However, the culture of mobility is evolving globally. The root course of this development is the changing values of citizens. This enables a future less dependent on ownership to be envisioned. Changing values are associated with behavioral changes. The possibility of change is based on the notion that in industrialized societies, people already have food, shelter, educational opportunities and health care—i.e., basic human needs are secured [8,9]. Thus, freedom, modernity and speed—the basic narratives associated with car culture—could be reframed [5,10] using ways of living that provide increased life satisfaction [11]. There is also another strong driver: personal health. The use of private cars has recently been limited in various cities in Asia due to health concerns, as well as in Europe, for example, in Paris, Madrid and Oslo. Air pollutants are one of the main sources of premature mortality. They are associated with multiple illnesses including cardiovascular diseases and lung cancer [12]. People are also moving from ownership to usership because there is little desire to turn cities into car parks. Moreover, the average speed of a vehicle in a major city during the rush hour is around 10–20 km/h [13]. This speed is the same as one hundred years ago, using horse transport. This is why vehicles are starting to be replaced by trouble-free access and good availability of other forms of mobility. This is demonstrated by the fact that in Germany, ownership of private cars is declining [14]. In Stockholm, only one in ten 18-year-olds has a driving license [15]. This trend has also been identified in Helsinki [16]. Thus, carbon-neutral mobility has already started to evolve and could be associated with several social benefits.

This article seeks to contribute to the behavioral aspects [17,18] within demand-side management of low-carbon mobility transitions [19] that tend to be neglected in favor of technological and economistic explanations and policies [20,21]. Finland is an interesting case due to its ambitious climate change mitigation goals. The aim is to halve emissions from transport by 2030 compared to the 2005 levels [22], and to have introduced carbon-neutral transport and mobility by 2045 [23]. According to the new Finnish Government, which was formed in June 2019: "The Government's decisions will put Finland on a path toward achieving carbon neutrality by 2035" [24]. In Finland, the transport sector is responsible for 17% of energy consumption and around 40% of oil consumption, [25] resulting in 20% of Finland's greenhouse gas emissions [26]. This represents a serious challenge, as nationwide per-capita trips based on walking and cycling (30% of all trips) as well as public transport (7% of all trips), have remained the same between 2010–2016, and private car use is the most dominant form (61% of all trips) [27]. However, roughly one half of trips made by car were seven kilometers or less [27], meaning that there is potential for a modal shift or for acceleration of intermodality.

Kivimaa and Temmes [28] note that policies in Finland have primarily focused on technological change within the private car regime. Thus, the most notable carbon reductions result from an increase in biofuels and improved energy efficiency. Furthermore, Liimatainen et al. [29] note that a sustainable mobility transition in Finland would be possible with a predominantly technological change, but that if this were the case, then societal improvements in terms of health or savings in energy consumption or non-car use would not be achieved. There would be also a sectoral trade-off: the emissions burden would shift from transport to energy production, potentially almost doubling transport sector emissions [29].

As suggested by previous research on low-carbon mobility in Finland [20,28,30], we aim to improve the understanding of values, attitudes and practices in sustainable mobility transitions. This article is based on multidisciplinary research drawing on sociotechnical analysis on sustainability transitions [6] and social justice [31] and placed in dialogue with sociopsychological research on well-being and travel satisfaction [17,18,32]. This enables us to provide a more systemic analysis beyond individual choice [6,33,34] with a focus on possibilities and constraints [35,36].

Our article is structured as follows: Following the introduction, we introduce the key literature and concepts we will use in our analysis, as well as the main research questions. Section 3 describes

data and methods. Section 4 provides the results by first presenting the quantitative part and then the qualitative part of the analysis. Section 5 discusses the results in relation to previous research. Finally, Section 6 concludes the article.

2. Mobility Transitions toward Carbon Neutrality

2.1. Sociotechnical Change and Sustainable Mobility

Considering the pace of the required change toward sustainable mobility, combining technological innovations with demand-side management and acceleration of innovations with sectoral policies, is vital for achieving such change [6,30,37]. It is equally important to phase out unsustainable technologies and practices [38] and start developing new sociotechnical systems [39] and strengthen their social embeddedness [39]. One of the most popular conceptualizations for sustainable mobility is developed by Banister [37]. The paradigm considers the elements of sustainable mobility are reasonable travel time, reduction of need for travel, consideration of travel as valued activity, modal shift in terms of walking and cycling, greater energy efficiency of vehicles and improvement of environment in terms of reduced noise and pollution as well as its quality [37].

Geels et al. [19] conceptualize sociotechnical change by looking at sustainable innovations between substantial and modest change in social practices and between technologically incremental and radical innovations. Thus far, policy initiatives have focused on incremental and modest changes such as improving vehicle fuel efficiency or promoting cycling and walking without challenging automobility [7,28,40]. Technologically radical, and socially substantial measures such as developing intermodal transport systems or compact cities are also increasingly being taken into account, for example, the EU-level policy on smart city, which aims to integrate sustainable mobility with quality of life [41]. However, transitions that would fully delegitimize car cultures in terms of habituation or behavior have so far been practically non-existent [5]. Beyond the techno-economic realm, transition is much more challenging and requires supportive policies, cultural discourses and societal pressure, as well as an understanding of the dynamics of the dominant system of automobility [5,19]. That is, lock-in mechanisms are not only technological [39], such as often considered in the literature of carbon lock-in [4], but also social, cultural and behavioural. Thus, a successful sustainability transition is more likely to result from a complex societal embedding [39].

The linkage with transport policy and climate and energy policies is often made through innovations in transport electrification, while also social concerns such as social justice [42] or potential transport poverty [43] are relevant. From the perspective of mobility justice [31] and energy justice [44], a shift to electric vehicles does not necessarily provide a just solution, as electric vehicles are still generally only accessible to middle class Western Europeans living in urban well electrified areas and do not necessarily reduce congestion. Self-driving cars that are also often associated with the electrification pathway may contain risks that have not been comprehensively assessed [10,45]. As Schwanen et al. [33] suggest one should be cautious when assessing the potential of new technologies, as they not only provide potential solutions, but also reconfigure intentions and behavior with unpredictable ways. Furthermore, although electric cars could be powered by low-carbon energy, the required minerals for batteries are finite and require integrated planning [46] and better understanding of life cycle costs [34]. Thus, the shift from the geopolitics of oil to the geopolitics of renewables is not necessarily more ecologically sustainable on a global scale, if the focus is on technological solutions only [47,48].

2.2. Behavioural Aspects of Sociotechnical Change

From the perspective of human behavior, the required change is complex. For example, responsiveness to pro-environmental taxes depends on cognitive ability. This implies that intelligence is a relevant variable to study as a moderator to choices that are carbon neutral [49]. Also, previous analyses have revealed that the life satisfaction of citizens is unrelated to their energy use [11]. However, according to the Jevons paradox, there is a behavioral tendency to consume more energy when its

production is made more efficient and thus cheaper, i.e., with a more efficient engine there is a tendency to drive further, which offsets some of the expected benefits. Or, instead of using money to buy petrol, the money saved will be used for other energy-consuming practices [50].

Technological innovations could be coupled with a fundamental change in the mobility behavior of citizens. Personal everyday mobility choices are not only associated with greenhouse gas emissions and sustainability, but also with other sociotechnical issues such as technological innovation, economic growth and energy security [51]. This also enables going beyond the focus on climate change, toward other social issues, including congestion, road accidents and spatial dominance of car [6]. While focusing on the situational and attitudinal factors that predict the everyday choices of citizens, it is also remarkable that non-situational, non-attitudinal, and non-cultural factors may influence their choices [36]. For example, there is a positive link between citizens' intelligence scores and their choice to co-own and lease their cars [52]. These factors are related to education and human growth. Believing that intelligence is a changing characteristic of a human being is a predictor for motivation and development as a human being, as opposed to considering intelligence to be an unchanging attribute of a human being [53].

Human behavior is motivated both egoistically and altruistically. Egoistically-motivated choices focus on the immediate benefit to the citizen, their friends or relatives. Meanwhile, altruistic choices foster trust between them [54,55]. Egoistically-motivated choices are related to subjective well-being (happiness) which is "an experiential state that contains a globally positive affective tone" [56]. The common way of measuring subjective well-being is to conduct an evaluative assessment of one's life satisfaction. Altruistic choices are related to meaningfulness. They cultivate fulfilment and the good life [57]. Altruistic choices require "an ability to put oneself in the position of those whose everyday existence our actions affect" [58]. Thus, altruistically motivated people think unselfishly. They are capable of extending their moral circle so that it combines human and non-human reality. Thinking of oneself as part of a greater whole or as a part of global or even planetary system is an essential element of the intention of altruistic behavior [59]. Meaning in life is also about thinking integratively about the past and future [56].

2.3. Satisfaction in Travel and Life and Modality Choice

Life satisfaction, well-being and happiness, often synonymously used concepts, have attracted interdisciplinary interest within transport research [18,32,60–62]. These studies also commonly assess how travel satisfaction is associated with life satisfaction, or vice versa [61,63,64]. The association between modality choice and life or travel satisfaction is manifold. In principle, the use of sustainable travel modes could be increased using multiple measures such as general promotion, road pricing or reward schemes [65]. In practice, however, the use of a car tends to be the preferred method of transporting family members or goods, due to time constraints or for reasons of comfort or convenience [65–67].

According to previous research, travel satisfaction is conditioned by multiple characteristics such as travel preference, characteristics of mode, quality of services, socio-economic features or social and physical environment [17,65,67]. Also, high life satisfaction tends to correlate with travel satisfaction: the happier we are, the more satisfied we are with travel [62]. The studies also differentiate between travel satisfaction and travel mood, of which the former is a combination of evaluating situational emotional reaction and cognitive utility, while the latter is only a situational affective reaction felt during activity, although it can be recalled [65,68]. The association between travel satisfaction and modality differs clearly between active modes, public transport and car use. Active modes, walking and cycling, in general, provide the highest levels of satisfaction, while car use intermediate and public transport has the lowest [17,62,63]. However, the level of popularity in specific modality or national culture can play a much more significant role than a feeling of convenience [61].

Differing approaches are used to assess travel behavior. Public health research applies theories of behavioral psychology and considers travel behavior to be influenced by intrapersonal,

interpersonal and environmental factors, while transport planning research often applies the utility theory, which describes the reason for traveling based on utility comprising travel time and costs, as well as additional factors [63]. Thus, differentiation between opportunities and constraints at the individual, social environment and physical environment level adds a more systemic approach to studying transport behavior [35,69]. Critics from other strands of social research have also acknowledged that there is a tendency to approach behavioral change from the perspective of attitudes, behavior and choice [70] or to portray citizens as consumers who base their explanations on rational choices [51,71]. Schwanen et al. [36] add that placing more emphasis on habits could advance sociopsychological studies of mobility. Habit engenders automatically elicited behavior and is impacted by the social and physical environment, as well as by previous practices. The strength of habit is based on cognitive effectiveness and it becomes durable if a practice continues to be confirmed as adequate and satisfactory [36]. Olsson et al. [61] remind us that daily routines also have an impact on life satisfaction, and being able to establish and maintain a routine can have a positive effect.

2.4. Research Questions

In this research, we aim to identify the potential of sustainable mobility behavior in Finnish citizens. We look at both transformative and incremental technologies, although the focus was on those technologies that could bring substantial change to social practices. We assess the potential of mobility decarbonization by reducing car use and increasing the use of public transport, as well as the physical activities of walking and cycling, by giving citizens a voice. They are free to explain the background of their mobility choices. In this sense we apply a phenomenological approach, often applied in new mobilities research [72,73], combining situational and non-situational, attitudinal and non-attitudinal, as well as cultural and non-cultural factors.

The research questions are: (a) What is the connection between life satisfaction and sustainable mobility? (b) How are mobility choices rationalized in day-to-day life in Finland? (c) What is the potential for more sustainable mobility? Factor analysis enables us to assess to what extent life satisfaction correlates with mobility choices, while qualitative analysis on open responses captures locational, activity and travel perceptions that influence behavior [35] and, finally, we assess the implications for the acceleration of sustainability transition.

3. Materials and Methods

The research data is based on a Finnish national survey concerning sustainable behavior. The questionnaire was developed together with the experts from the Finnish Innovation Fund Sitra. For this article we used data on mobility choice. As the survey includes both quantitative and qualitative data, we also made the pragmatic choice of applying quantitative and qualitative methods in order to improve the validity of our data.

Our quantitative analysis focuses on variances between different groups of citizens when choosing sustainable mobility, while the qualitative analysis studies the main drivers and key obstacles to choosing sustainable mobility, i.e., the quantitative data depict life satisfaction on a more generic level, while the qualitative data depict how Finnish citizens perceive possibility for a modal shift and the potential strategies for achieving this goal. Figure 1 depicts the research design in more detail.

Data (n = 2052) were collected via a questionnaire in April 2017 by the TNS Gallup Forum panel. The panel was comprised of 40,000 respondents representing the population of Finland (18–79 years of age), excluding Åland. The socio-demographic characteristics of the sample are presented in Table 1.

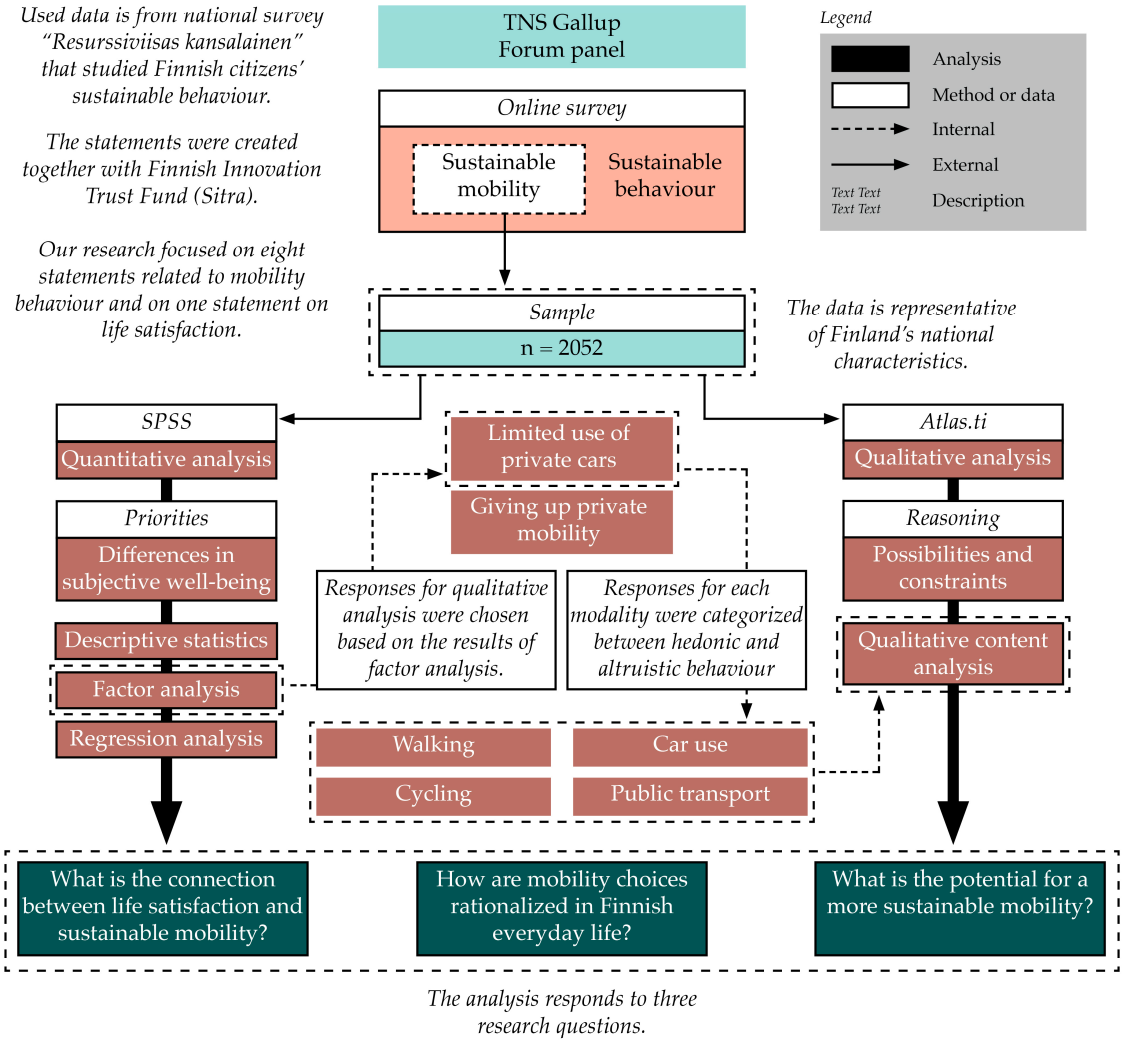

Figure 1. Study flow chart.

Table 1. Socio-demographic characteristics of the sample.

Socio-Demographics	n	%
Gender		
Female	1048	51.1
Male	1004	48.9
Age		
<30	210	10.2
30–39	236	11.5
40–49	429	20.9
50–59	310	15.1
60–69	529	25.8
>70	338	16.5

Respondents were asked to respond to eight statements about their mobility habits and routines in everyday life. We also asked them to evaluate their life satisfaction by responding to the proposition: "Generally, I am satisfied with my life". The response pattern followed a 5-point Likert scale (1 = totally disagree, 5 = totally agree). The eight statements associated with sustainable mobility were as follows:

- I walk more often from point A to point B than use a car or public transport.
- I reduce the use of my car.
- I try to minimize the environmental effects of mobility.
- I cycle whenever the weather is good.
- I choose public transport even though I have the option to use my own car.
- I offer ridesharing with my car.
- I'll probably stop using my own car within the next couple of years.
- I am ready to lease my car to a car-sharing service.

Those respondents that had rated their mobility habits and routines in the Likert scale to 4 to 5 (agree or totally agree), were also asked to provide written explanations of their mobility behaviour. The respondents submitted 2335 explanations as to why they considered a specific sustainable mode of transport and mobility to be important to them.

Quantitative analyses of the data were delivered with SPSS. Exploratory factor analysis helped us to understand the structure of variables [74]. We were interested in learning which items in the set formed coherent subsets that were relatively independent of each other [75]. We applied the principal axis method. When applying the principal axis method, there is only a minimal dependence between factors. We are aware that this makes it easier to interpret the results but may reduce exemplification of the phenomenon [75]. After factor analysis, we applied regression analysis—based on factor points—in order to establish whether or not the identified factors could explain the respondents' life satisfaction.

The qualitative data (written explanations) were analyzed using ATLAS.ti version 8.4.3. (build 1077, release date 24 July 2019, Berlin, Germany), a qualitative data analysis software. The data were analyzed using data-based content analysis as we had not formed any hypotheses [76–78]. We did not consider other qualitative methods such as discourse analysis [79], as the responses were often shorter than sentences, for example, single words such as "health", "environment", "savings", and so on. The method we applied enabled the researcher to describe the meaning of the qualitative data systematically [80]. The content analysis accurately adhered to the following format: (a) reducing the data, (b) regrouping the data, and (c) interpreting and drawing conclusions based on the data [78]. We started our analysis by thoroughly reading multiple times the written comments of the respondents. We divided words and phrases into separate areas and reorganized them according to how the expressed views related to previous research on mobility behaviour. Some of the data were discarded at this point due to their irrelevance. As respondents often gave multiple reasons for their activity, therefore the number of categorized answers exceeds the number of responses from the survey question.

4. Results

4.1. Quantitative Analysis of the Data

The most commonly identified change in mobility behavior was increased walking instead of using a car or public transport. A total of 44.6% of the respondents agreed or totally agreed with the first statement in the table (see Table 2). The two least common types of mobility preferences were the ambition to give up a car in the near future (9.8%) and a readiness to start using car-sharing services (6.8%). A total of 71.0% of respondents agreed or totally agreed that they were satisfied with their lives as a whole. The results of the descriptive statistics of the data are presented in Table 2. The data include the name of the variable, number, mean, standard deviation, number of respondents who responded positively (agreed or totally agreed, from the largest to the smallest). The last variable is related to the respondents' life satisfaction.

Table 2. Results of descriptive statistics.

Variable	n	Mean	Std. Deviation	Agree or Totally Agree (n)	Agree or Totally Agree (%)	Written Explanations (n)
I walk more often from point A to point B than use a car or public transport.	2021	3.1	1.3	902	44.6	546
I reduce the use of my car.	1445	2.9	1.3	522	36.2	363
I try to minimize the environmental effects of mobility.	1985	2.9	1.2	679	34.2	304
I cycle whenever the weather is good.	2008	2.7	1.5	669	33.3	441
I choose public transport even though I have the option to use my own car.	1936	2.6	1.4	608	31.4	385
I offer ridesharing with my car.	1430	2.4	1.3	352	24.7	209
I'll probably stop using my own car in the next couple of years.	1381	1.6	1.1	135	9.8	56
I am ready to lease my car to a car-sharing service.	1402	1.5	1.0	95	6.8	31
Generally, I am satisfied with my life.	2044	3.7	0.9	1452	71.0	-

Following this, we continued with an explorative factor analysis that was conducted on the eight variables that described the implementation of sustainable modes of mobility in the everyday lives of the respondents. We were interested in learning how our respondents' mobility intentions and behavior could be structured.

First, we verified that factor analysis could be conducted on the eight variables. The Kaiser–Meyer–Olkin (KMO) measure verified the sampling adequacy of the analysis (KMO = 0.82), which was above the acceptable limit [81]. Bartlett's test of sphericity, $\chi 2$ (21) = 2488, $p < 0.000$, indicated that the correlations between variables were sufficiently large for principal axis factoring. We verified that the correlations in the correlation matrix were not too strong (>0.8), thereby causing multicollinearity to prevent the presentation of results. The strongest correlation was 0.5, meaning the results could be presented [82]. We applied the principal axis method for factor extraction. The analysis was based on the correlation matrix. Using orthogonal rotation (varimax), we reduced small factor loads and enlarged the large factor loads in order to help with the interpretation of the results [75]. The eigenvalue was defined as greater than 1, according to Kaiser's criterion.

Table 3 shows the results of the factor analysis, which was used to analyze the respondents' actual mobility behavior. Communalities and factor loadings of variables as well as the explained variance and alpha values of factors are presented. The variables included in the interpretation of results are in bold. The extraction method used was principal axis factoring and the rotation method was Varimax (with Kaiser normalization).

We ended up with a two-factor solution that explained 56.8% of the variance. The results were justified by Cattell's scree test as the third factor would not substantially increase the explanatory power of the phenomenon. We named the factors (a) "Limited use of private cars", related to an optimization of using own car, and (b) "Giving up private mobility", which refers to social exchange-based access modes. The lowest loading included in the interpretation of the analysis was 0.5, which surpasses the limit defined by Howitt and Cramer [83]. Cronbach's alpha was used as a reliability analysis. It measures the consistency of the factors. The analysis was conducted on the items that loaded more

than 0.4 and the limit of 0.32 defined by Tabachnik and Fidell [75] was surpassed. The overall reliability of the factors was 0.6 or above, meaning the results can be presented [74,84].

Table 3. Results of factor analysis concerning the respondents' mobility behavior.

Variable	Limited Use of Private Cars	Giving up Private Mobility	Communality (Extraction)
I walk more often from point A to point B than use a car or public transport.	**0.794**	0.149	0.653
I reduce the use of my car.	**0.626**	0.319	0.494
I try to minimize the environmental effects of mobility.	**0.573**	0.280	0.407
I choose public transport even though I have the option to use my own car.	**0.556**	0.267	0.381
I cycle whenever the weather is good.	**0.546**	0.158	0.323
I am ready to lease my car to a car-sharing service.	0.140	**0.820**	0.692
I'll probably stop using my own car in the next couple of years.	0.284	**0.498**	0.329
I offer ridesharing with my car.	0.216	**0.453**	0.252
56.8% variance explained	42.8	14.0	
Cronbach α	0.8	0.6	

After factor analysis, we applied regression analysis in order to establish whether or not the identified factors could explain the respondents' life satisfaction. The value of the Durbin–Watson test was 1.952, suggesting that the residuals do not correlate and the results can be reliably presented [74]. The collinearity tolerance was slightly less than 1 and variance inflation factor (VIF) was below 10, which also suggests that the results can be reliably presented [85]. There was a strong relationship between the respondents' limited use of private cars and their life satisfaction (Table 4). The limited use of private cars significantly predicted the increased life satisfaction of the respondents. However, we found no relationship between the respondents' readiness to give up private mobility and their life satisfaction.

Table 4. Relationship between mobility behavior and life satisfaction.

Coefficients *							
Factor	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Limited Use of Private Cars	0.191	0.027	0.196	7.072	0.000	0.965	1.036
Giving up Private Mobility	−0.036	0.029	−0.035	−1.243	0.214	0.965	1.036

* Dependent Variable: Generally, I am satisfied with my life.

4.2. Explanations behind Mobility Choices

Based on the factor analysis (Table 3), we focused our qualitative analysis on the variables under the category of "Limited use of private cars", as they correlate the most with life satisfaction and also have the largest proportion of open responses. The factor comprises five variables with the potential for emissions reduction. In addition to walking, which has the strongest correlation with life satisfaction, we also assessed cycling as the number of responses was second largest. We then looked at the arguments for public transport and reducing car use that were the third and fourth most common categories in our data. The remaining categories were not analyzed as the number of responses would

have been less than one tenth of all the responses. We divided clustering in each category between altruistic and hedonic reasoning. However, these categories overlapped and were not always clear, because, for example, living without public transport could be a conscious choice but could also result from a structural change in population density.

For each category we deleted responses that provided little or no argumentative value, such as stating "yes" or "no", "if possible", references to other forms of mobility offering any argument, comments on frequency ("often", "at times", "always"), responses that repeated the question or ambiguous comments. We also did not include arguments that referred to lack of a car or driver's license without any further explanation, although they arguably depict the cultural dominance of automobility [5].

4.2.1. Walking

Walking was the category with the largest number of responses. We analyzed 481 responses associated with walking that resulted in 14 categories and 621 arguments (see Table 5).

Table 5. Clustering of reasons for walking.

Code	Description	Number of Responses	%
	Hedonic Reasoning		
Physical strength	Arguments related to improvement of physical strength.	145	23.3
Health	Arguments related to health in general.	132	21.3
Convenience	Arguments for the general convenience of walking such as speed, freedom from timetables, etc.	46	7.4
Personal Finances	Arguments related to cost savings on fuel or public transport.	38	6.1
Services	Arguments related to grocery shopping, postal service, medicine or walking in general being part of other daily practices.	29	4.7
Commuting	Walking to work.	10	1.6
Carrying Goods	Ability to carry goods.	8	1.3
	Altruistic Reasoning		
Distance	Arguments related to distance as enabling or disabling the option to walk.	76	12.2
Environment	Arguments related to pollution or carbon emissions.	49	7.9
Area	Arguments related to living area as enabling or disabling the option to walk.	41	6.6
Access	Arguments related to quality of infrastructure or lack of public transport.	17	2.7
Time	Lacking time to walk.	12	1.9
Habit	Walking is a habitual routine or main choice for mobility.	10	1.6
Seasons	Season or weather.	8	1.3
Total		621	100

The two most common arguments for walking focused on individual health. The majority of categorized responses stressed the physical aspect of walking, while the second most common category of responses comprised more general aspects of health, sometimes associated with an improvement in mental well-being or the positive impact of being outdoors.

The third most common category was the environment, which could be divided into avoiding local pollution in terms of small particles and avoiding carbon dioxide emissions. Although preserving or protecting the environment was one of the most commonly used arguments, walking was only linked with being in nature and its associated mental health benefits a few times. We merged these few references into the "health" category.

The answers to "Personal finances" were based on the rationale for saving money, whether it was related to the cost of public transport tickets, the cost of fuel or the cost of visiting the gym. Walking does not cost anything.

The fourth most common category was convenience linked to multiple elements, although the sense of freedom, especially in terms of timetables, was the most common theme.

Three categories are linked to access to mobility. The category of access comprises argumentation based on a lack of something, i.e., although area and distance also provide information on access, this category refers to quality of mobility services. A lack of proper public transport or a lack of car ownership provided the rationale for walking. In comparison, the categories of distance and area are linked to space as a constraining and enabling factor. A recurring theme was that respondents lived in an urban area or city center and the density of a living area was the key rationale that provided the grounds for choosing to walk. Furthermore, the quality of infrastructure was a constraining factor for increased walking. Area and distance were also used as grounds for not walking, with a few kilometers being mentioned as the maximum distance.

The fifth most common category was "Services", referring to walking as being part of day-to-day practices, such as visiting a supermarket or a service such as gym.

4.2.2. Cycling

We analyzed 364 responses associated with cycling. The analysis resulted in 14 categories, while the number of arguments was 500 (see Table 6).

Table 6. Clustering of reasons for cycling.

Code	Description	Number of Responses	%
Hedonic Reasoning			
Physical Strength	Arguments related to improving physical strength.	104	20.8
Health	Arguments related to general health.	75	15.0
Convenience	Arguments for the general convenience of cycling such as speed or freedom from timetables.	52	10.4
Personal Finances	Arguments related to saving costs on fuel or public transport.	32	6.4
Commuting	Cycling to work.	19	3.8
Services	Arguments related to grocery shopping, postal service, medicine or cycling generally being part of other practices.	14	2.8
Carrying Goods	Ability to carry goods.	6	1.2
Altruistic Reasoning			
Seasons	Arguments related to weather or season, such as cycling during the summer only or questioning the rationale that cycling requires good weather.	70	14.0
Environment	Arguments related to pollution or carbon emissions.	39	7.8
Time	Lacking the time to cycle.	29	5.8

Table 6. *Cont.*

Distance	Arguments related to distance as enabling or disabling the option to cycle.	28	5.6
Habit	Cycling is a habitual routine or main choice for mobility.	15	3.0
Access	Lack of other forms of mobility, poor level of public transport or quality of infrastructure enabling or disabling cycling.	13	2.6
Area	Arguments related to living area as enabling or disabling the option to cycle.	4	0.8
Total		500	100

In many ways, the arguments were similar to walking. The arguments were about the combination of health, environment and personal finances. Probably due to the fact that weather was mentioned in the open question, the argument about weather and seasonal variations was the third most common category. Responses in this category could be roughly divided into two groups: those that mentioned cycling only in good weather in the summer and those that cycled every day and considered it to be generally about wearing the right clothing and motivation.

Exercising and improving physical strength dominated the argument about cycling in the same way as the argument about walking. This also applied to the argument about the environment, mainly relating to pollution. Personal finances in terms of cycling provided a slightly more nuanced picture, as saving energy was more pronounced than for walking. Finally, lack of time was a three-times more frequent response to cycling than to walking.

4.2.3. Public Transport

We analyzed 273 responses associated with public transport. As a result, we developed 12 categories with 355 arguments in total (see Table 7). Compared to walking and cycling, health was only slightly used as grounds for an argument. The same applied to commuting, which was only mentioned a few times, while using public transport to access services was generally not mentioned at all. Instead, the most common arguments for using public transport were convenience, finances, access and environment. Arguments based on the category of convenience were also more nuanced than for walking and cycling. As public transport enables safer multitasking than the aforementioned forms, activities such as sleeping, reading or socializing with children were associated with increased levels of convenience or comfort. Because of these aspects, spending slightly more time for traveling compared to using a private car was justified. The specific survey question included the assumption of already owning a car, although we did not include responses that referred to a lack of car ownership in our analysis if they did not include any further arguments.

To some extent, the code "distance" also depicted a willingness to combine forms of transport, although, in practice, using public transport always included walking or cycling before reaching the desired destination. The argument for health in this category also explicitly referred to the same practice, while there were also few references to public transport as reducing stress when referring to convenience. The most frequent description was using public transport for longer distances and walking, cycling or using a private car to reach the closest node to provide public transport. Meanwhile, the access category highlighted the relevance of social injustice and the general ability to be mobile [42] that can also translate into transport poverty. Although there is motivation to use public transport, a total lack or insufficient availability of public transport is a factor that forces people to use their cars. This highlights the fact that the that level of intention is quite weak. Compared to cycling, lack of time was mentioned only a few times and it has been merged into the "access" category.

The idea of a travel chain or intermodality—combining different modes of mobility—was only explicitly stated on a few occasions. Similar argumentation can be found in the code "parking".

Many of the respondents referred to issues related to parking spaces, but it may also be linked to travel chain: the respondent had no access to public transport for the first part of the trip and therefore initially used a private car that was then parked to the closest node to provide public transport.

The category for reducing automobility refers to multiple reasoning. Avoiding congestion and a commitment to avoiding car use were most frequently mentioned. A commitment to avoiding car use did not usually include any specific references to measures that also apply to comments that referred to car use as being "not convenient". In terms of implicit references to specific measures, car sharing or renting a car were mentioned a few times, as well as intermodality. Compared to argumentation related to parking spaces, this reasoning depicted a clearer willingness to change behavior, whereas those respondents who considered parking spaces an issue would probably have continued to use a car if the parking had improved. That is why we consider that this type of behavior is likely to be more hedonic.

Table 7. Clustering of reasons for using public transport.

Code	Description	Number of Responses	%
	Hedonic Reasoning		
Convenience	Arguments for the general convenience of public transport such as speed or ability to focus on practices that increased satisfaction.	69	19.4
Personal Finances	Arguments related to saving fuel costs or the low cost of public transport.	56	15.8
Parking	Arguments about difficulties in finding a parking space.	34	9.6
Health	Arguments related to general health.	10	2.8
Carrying Goods	Ability to carry goods.	7	2.0
	Altruistic Reasoning		
Access	Arguments about lack of public transport or lack of sufficient timetables.	47	13.2
Environment	Arguments related to pollution or carbon emissions.	45	12.7
Reducing Automobility	Arguments for reducing congestion, general commitment to avoiding car use or negative association with automobility.	28	7.9
Distance	Arguments related to distance as enabling or disabling the possibility of using public transport.	27	7.6
Area	Arguments related to living area as enabling or disabling the possibility of using public transport.	23	6.5
Other	Arguments related to safety, habit or commuting.	5	1.4
Conditions	Arguments related to weather or season.	4	1.1
Total		355	100

4.2.4. Reducing Car Use

We analyzed 304 arguments associated with private car use. We developed 12 categories that include in total 423 answers (see Table 8). Savings on fuel costs were the most common argument for reducing car use. The most common factors for enabling the reduction of car use were distance, living area and availability of alternative mobility services. These are respondents living in urban or densely populated areas who are able to cycle, walk or use public transport instead of a car. In comparison, those respondents living in less densely populated areas with longer distances opted for an optimization strategy.

"Necessity" and "optimization" are quite similar categories. The difference is in using necessity as an argument for legitimizing car use, often without further arguments or questioning car use for

anything other than basic needs. Whereas for optimization, the concept refers to active planning in terms of efficient routes and timetables as well services. This refers to reducing the number of trips by buying more goods simultaneously, combining leisure and commuting or using a car for recreational trips only, for example, visiting a summer cabin.

Compared to other assessed modalities, convenience was not explicitly mentioned as a reason for using a car and was not associated with recreation. Rather, if a car was being used, it had to be based on rational explanations.

Table 8. Clustering of reasons for reducing car use.

Code	Description	Number of Responses	%
	Hedonic Reasoning		
Personal Finances	Arguments related to saving on fuel costs.	100	23.6
Mode	Arguments related to using other modes of transport.	82	19.3
Necessity	Arguments related to using a car for basic needs only, not for pleasure purposes.	72	17.0
Optimization	Arguments related to reducing car use by linking it with other routines or using planning and scheduling to reduce usage.	31	7.3
Health	Arguments related to general health.	14	3.3
Recreation	Using the car for leisure purposes only, often to travel to a summer cabin.	14	6.6
	Altruistic Reasoning		
Environment	Arguments related to pollution or carbon emissions.	28	6.6
Services	Arguments related to supermarket, shopping, postal service, medicine.	22	5.2
Distance	Arguments related to distance as enabling or disabling the possibility of using a car.	18	4.2
Access	Lack of public transport.	16	3.8
Area	Arguments related to living area as enabling or disabling the possibility of using a car.	15	3.5
Inconvenience	Arguments for the general inconvenience of car use.	11	2.6
Total		423	100

5. Discussion and Concluding Remarks

5.1. Life Satisfaction and Modality

According to our quantitative analysis (Table 3), the sustainable mobility behavior of citizens is characterized by two factors: The first factor, "Limiting use of private cars", is related to an optimization of using own cars and the second factor, "Giving up private mobility", refers to social exchange-based access modes. The limited use of private cars significantly predicted an increased life satisfaction of the respondents and is in line with previous research that stresses a high correlation between walking and cycling and life satisfaction [17,61–63]. Our research is more generic compared to previous research that has assessed life satisfaction in specific cities [63] or during specific activity, such as commuting [61]. However, regardless of geographical scope, this appears to be consistent phenomena. Studies that apply satisfaction to a life scale [86], as well as studies that ask a single question about how generally satisfied respondents are with their lives [32] indicate similar results.

This may also be due to changing values [8,9]. People who live in well-being societies may have started understanding that nothing material is intrinsically valuable. However, this outcome is limited

because we did not identify any relationship between the respondents' readiness to give up private mobility and their life satisfaction.

5.2. Behavioural Intentions Regarding Sustainable Mobility

In practical terms there is a belief that car ownership and usage is considered a "necessary evil" that is to be avoided whenever possible, often for hedonic reasons, such as personal health, personal finances or convenience, while altruistic reasons, such as reducing pollution or greenhouse gases, are less frequently mentioned. For instance, if one considered health as public issue and concern it could have been considered as altruistic, but according to our analysis such argumentation was not used. We found that the carrying capacity of the transport mode is an essential reason for mobility choices. According to our results, the only perceived solution for addressing larger carrying needs is a private car. Recent studies, for example [87], suggest that electric bicycles, to some extent, could answer this issue and reduce use of the private car and also improve the convenience of carrying goods to some extent.

Concerns about health and physical strength dominated the responses to walking and cycling (Tables 4 and 5) which, according to research, are also the most common elements for increasing modality-specific satisfaction [63,65]. Also, most of the other responses between these two categories were almost identical. The only exceptions were distance, which was around twice more significant enabling or disabling factor for walking. In comparison, responses to weather contained many more responses to cycling. This is in line with previous research indicating that a positive stance toward a specific modality predicted its high usage, although situational factors such as weather affected attitude [63].

Responses to reducing car use and public transport use were much more varied, but they also generally followed the results of previous research. The high proportion of the convenience category in public transport to some extent highlights the observation from previous research that the ability to do other things increases satisfaction [17] and that improving speed does not necessarily directly increase a preference for public transport. Furthermore, this also somewhat contradicts previous research [68] that highlighted the strongest negative association with public transport. As convenience and travel satisfaction are not the same notions, further research could assess this relationship in further detail. We also find it interesting that commuting was only mentioned in relation to walking and cycling, while public transport is equally common modality for such purpose [66].

5.3. The Potential for a More Sustainable Mobility

According to Kivimaa and Temmes [28], significant progress has been made toward sustainable mobility in terms of the creation of niches for new technologies and experimentation coupled with regime level support from the Ministry of Transport and Communications and other public authorities. While young persons are less interested in owning a car, cars tend to dominate, particularly outside central areas [28] and flying abroad has constantly increased [88]. Our results revealed similar results and that many of the explanations about mobility solutions are still based on a culture of automobility [5], although there are signs of a willingness to change behavior toward carbon-neutral mobility and to develop varying strategies for responding to this challenge. We also learned that there are concerns about social (in)justice and transport poverty, epitomized by the arguments for the lack of public transport or the low quality of public transport. However, frequent mentions of convenience in terms of public transport highlight the potential for socially substantive change.

Our research is in line with previous research on sustainable mobility transitions that concluded that in order to make cycling, walking and public transport more desirable, interventions in the broader system of mobility—from technology and infrastructure to practices and cultural preferences—appear to be a more efficient way of achieving behavioral changes than encouraging citizens to change their behavior [36,89]. Previous research on sustainable mobility suggests that sustainable transport policies are most effective when they are a combination of the negative and the positive, i.e., if one wants to

decrease the dominance of car culture, car use must be made more difficult, while low-carbon forms of mobility must be enabled and improved in terms of quality, convenience, safety and security [6,34,37] as well as embedded culturally [39]. Also, improvements to the urban environment and service locations provide benefits [90], while some features of design and technology have received less attention. For instance, according to Heinen and Buehler [91], there are some indications in the literature that improving the quality and safety of bicycle parking could increase bicycle use. In our results, we noted a frequent concern about car parking spaces, while for cycling such arguments were not used.

Furthermore, the literature on positive self-concepts [65] and motility [42,92] stresses that access to multiple modalities and pursuing skills and knowledge about them could establish a sense of freedom, competence and belonging, which, in turn, could generate confidence and the perception of attaining other life goals [92]. This also links to the literature on habits [36], highlighting the fact that knowledge of previous practices could be used in order to regain their use. Walking, cycling and the use of public transport are already familiar and routine activities in childhood and the avoidance of educational messages supporting automobility could therefore also play a role. Furthermore, pensioners have more time, partially indicated also in our analysis, and it is a potential enabler for them to return to walking and cycling, previously more common forms of transport. A recent study by Laakso [93] also highlights the relevance of social support in workplace, as those respondents who increasing their cycling had to justify their behavior to their peers if they used a bicycle as their main form for mobility instead of a car or walked a few kilometers in order to access public transport. This applies to broader social aspects of mobility as well. That is, establishing more liveable communities in general by supporting civic initiatives could increase social belonging and positive attitudes towards localised and active mobility [31], as advocated by sustainable mobility paradigm [37].

Our results in the "access "and "time" categories, including references to specific modality as being the only option or being forced to use a specific modality because of time constraints, highlight the fact that improving current services and innovating new ones could help to accelerate change. In previous research this has been highlighted with the notion of "forced car ownership" [43]. The deleted comments included "if I only could", indicating that there are potential cultural, psychosocial or infrastructural barriers that limit niche development with more sustainable mobility practices. This highlights the limitations of promoting green consumerism [71]. It is vital, instead, to understand the broader systemic aspects, as well as the need to address the disparities within societies, including those disparities between urban and rural areas [94].

Finally, broader literature on low-carbon transitions stresses the relevance of co-benefits [95]: Framing issues as "green" or "sustainable" has limits as it does not resonate with whole population, that also our research highlights. Rather, having a comprehensive view on the impact of sectoral policies [28], and connecting it with more popular public concerns, such as personal health, employment, or security [95] may accelerate change more effectively.

5.4. Limitations of the Study and Future Research

As the study is based on survey data, it probably does not fully capture the cyclicality between modality choice, attitude and travel satisfaction [63]. Ettema et al. [17] also note that memorizing previous behavior tends to overestimate both positive and negative emotions. Furthermore, as our data is nationwide, regional differences are not fully visible [96]. Schwanen and Wang [69], for example, found that geographical context and satisfaction correlate. Thus, it is likely that there are regional differences. The qualitative part of our analysis helped to alleviate this issue because by looking at arguments for area, distance and access, we were able to achieve a more nuanced picture between urban and suburban areas and the quality of services and infrastructure.

The survey questions between different modalities differ slightly and resulted in varying results. Thus, direct generalizations between modalities cannot be made, while voluntary responses to open questions depict nuances within the theme, but, unlike the quantitative data, do not represent the whole population.

As there is variation in terms of modalities and practices associated with them, the public transport category must be assessed carefully. The notion may refer to bus, train, metro, aviation or even public bike-sharing services that have potentially different association with travel behavior and satisfaction. As rail-based transport tends to achieve higher travel satisfaction than road-based transport [62], it is likely that, for example, a high level of convenience associated with public transport in our data refers to the convenience of the light rail and metro system in Helsinki or the train in other parts of the country.

Also, it is worth noting that new modalities have only gained popularity in recent years in Finland. As our data were gathered in April 2017, this may be the reason why emerging trends, such as car or bicycle-sharing programs, electric bicycles, electric cars or mobility services were only rarely mentioned in the open responses. For example, city bike systems started in Helsinki in 2016, in Espoo and Turku in 2018 and in Kuopio in 2019.

Due to the limitations of the survey, we could not focus in detail on social, regional or situational aspects. Thus, future research could link an assessment of behavioral change with broader practices that sustain this type of behavior. Also, the development of comparative studies, for instance, between urban and rural areas, could improve our understanding of life satisfaction and mobility choice.

Furthermore, as we did not assess the qualitative data on the social exchange-based access modes, it would be useful to know in the future whether or not their usage is associated with meaningfulness. Moreover, is it true that people living in well-being societies are increasingly searching for a higher meaning in their lives rather than owning more goods and commodities such as cars.

6. Conclusions

This study assessed the correlation of sustainable modal shift with life satisfaction and further investigated how modal shift and intermodality could support a sustainable mobility transition. Based on our quantitative analysis, there is a high correlation with life satisfaction and walking, while our qualitative analysis depicts that reasoning tends to be dominated by car culture and hedonic concerns such as health and finances, while altruistic reasoning such as environmental protection are less frequent concern.

Our main conclusion is that a profound shift in mobility behavior is possible when citizens recognize that their life satisfaction can be combined with ecological and social benefits. By shifting mobility behavior, people achieve co-benefits on various levels by combining their hedonic and altruistic needs. Our results also highlight the fact that improving the level of access in terms of quality of service and public transport timetables could increase use, as well as reduce social exclusion. Finally, the transition is more likely to be achieved when it is systemic, that is sustainable technological embedding is supported by cultural, political and behavioural embedding of sustainable lifestyles.

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