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The Role of Personal Identity Attributes in Transport Mode Choice: The Case Study of Thessaloniki, Greece

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Abstract: People make numerous trips every day for a variety of purposes. Transport mode choice directly impacts travel time, congestion, and environmental conditions. It also depends on various economic, social, environmental, and personal related factors. This paper investigates the association between identity characteristics and transport mode choices in Thessaloniki, Greece. A customized questionnaire survey was carried out with 506 individuals in 2019 to collect data on nine self-declared personal statuses (affiliation with environment, place of residence, career, companionship, etc.) and trip frequencies of all available transport options in Thessaloniki. We ran latent class analyses to uncover three identity clusters. The Active individuals prefer public transport over private car, and they are mostly young, sporty, and with low incomes. Additionally, the Family-Oriented individuals are comparatively older, and they have greater access to private cars and higher incomes, while the Typical Urban population exhibits a slightly higher use of cars and public transport than the Active one. Trips on foot and by car (as passengers) are equally preferred by all latent classes' populations. Our findings highlight the role of individuals' identities in the development of travel behavior and may assist with the design of targeted policies and marketing strategies, which will facilitate sustainable urban mobility behaviors.

Keywords: mode choice; trip frequency; personal identity attributes; self-determination; travel behavior; public transport; latent class analysis; personal lifestyle; urban transport

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1. Introduction

The evolutions of city patterns and mobility planning have undergone several changes due to the recent pandemic and ongoing crises in various parts of the world. Today, it is even more necessary to define strategies and actions that can mitigate the impacts generated by the aforementioned events and enable the partial or total resolution of certain urban problems, such as possible vehicular traffic congestion, the absence of transportation services in areas of weak demand, or even the choice to use private vehicles instead of other, more sustainable forms. A careful analysis of mobility demand makes it possible to delineate the profiles of main users and define useful parameters to improve transportation services and urban planning, such as travel frequencies and their motivations. The characterization of prevailing activities is also useful for classifying and possibly defining clusters of users who share similar lifestyles (Campisi et al. 2022a, 2022c). In this context, the contemporary concept of Mobility as a Service (MaaS) further demonstrates the importance of recognizing people (both users and non-users of MaaS) as a basic element of sustainable urban transport systems whose travel needs, preferences, and expectations should guide the decision-making of transport operators (Vitetta 2022).

Several factors can affect mobility choices as the literature of the last two decades points out. Along with travel time, travel cost, and possession of transport means (e.g., private car),

which are traditionally regarded as mode choice determinants (Torrisi et al. 2021), recent research has demonstrated that factors related to modern technologies' skills (Campisi et al. 2022b; Derikx and van Lierop 2021), environmental concerns (Balest and Stawinoga 2022; Boglietti et al. 2021; Sovacool et al. 2018), sociocultural and psychological factors, (Campisi et al. 2022c; Cottle Hunt and Caliendo 2022; Marchetti et al. 2022) and personal identity attributes (Heinen 2016; Murtagh et al. 2012; Parsha and Martens 2022) may also play an important role in travel mode decisions. Therefore, any new investment and subsequent operation of sustainable transport systems should integrate all these personal concerns by emphasizing the contribution of low-carbon transport schemes to environmental protection and social well-being and by highlighting their simple and easy use by citizens of all backgrounds and their continuous quality-of-service improvement.

This paper investigates the relationship between self-identity characteristics and trip mode choice. Based on questionnaire survey data from 506 individuals in Thessaloniki, Greece, we developed nine (9) variables of self-identity items which quantified the self-declared positioning of respondents against environmental, physical activity, health, personal relationship, career, creativity, etc. aspects. We used latent class analysis to unlock hidden self-determination aspects which enabled us to group individuals under overarching identity labels. The socioeconomic composition and trip mode choice behavior of each latent class population was investigated using appropriate inferential statistical analyses.

The next section provides a literature review about the relationship between travel mode choice and personal identity attributes. Section 3 describes the study area, the data we collected, and the methods we used for our analyses. The results are presented and discussed in Section 4, while Section 5 is devoted to the conclusions of our research.

2. Literature Review

Assuming that mobility is a fundamental social issue, this article addresses the associations that exist between trip mode choices and personal identities. Giddens's (2020) socio-historical approach describes the transition in the last century from (prescribed) place-based identities to (realized) mobile identities, and recent theories in sociology see identity as mobile, dynamic, hybrid, and relational, while recent theories in geography consider the relationship between place and identity. A study conducted by Easthope (2009) highlights that both mobility and place are essential components of the construction of identity, and it is necessary to analyze the complex interrelationships between mobility, place, and identity.

Social and self-identity often influence travel mode choice behaviors and intentions to change them. A study by Murtagh et al. (2012) demonstrated, using multiple and logistic regression analyses, that certain self-identities of 248 survey respondents in the UK, such as parent, worker, motorist, cyclist, etc., are significantly related to their trip mode choices for commuting and other travel purposes. Heinen (2016) investigated the association between identity and trip mode choice by exploring a sample of 1062 respondents in the Netherlands and employing multinomial regression modelling techniques. The participants were classified against 17 identity items related to place of residence, transport mode, and self-determination aspects. The author found that respondents who were users of a specific transport mode showed a comparatively lower willingness to change it, while specific identity items, such as family-oriented and sporty, were highlighted as significant predictors of travel mode choice (Heinen 2016). Cycling has been recognized as an integral element of self-characterization in a study by Bhandal and Noonan (2022). In Tel-Aviv-Jaffa, Israel, Parsha and Martens (2022) discovered important associations between social identities and cycling modal shares among women. Specifically, cycling was considered a typical activity of individuals who follow a healthy or active lifestyle, while e-bikes were particularly associated with travel mode choices made by men (Parsha and Martens 2022).

Several factors, both endogenous and exogenous, can pose a threat to one's identity, and can therefore generate facilitation or resistance to change. Endogenous factors include aspects directly related to the user, such as psychosocial aspects (i.e., stress, fear, and feelings of fatigue) that may reduce the propensity to travel or use certain modes of transportation

(Campisi et al. 2022c). Social aspects, safety, security, and risk sharing play an important role regarding economic development and intergenerational mobility (Cottle Hunt and Caliendo 2022). Exogenous factors include, for example, changes in the origin or destination of travel, ownership of the means of transport, and restrictions imposed by government authorities. In particular, a change in the location of work activities is also a factor of change; for example, a large portion of the world's population has been subjected to teleworking and distance learning since 2020 (Campisi et al. 2022b).

Similarly, modal choice may be influenced by the availability of transport means. Some studies have investigated the differences between owned, rented, or shared means of transportation regarding recent modes of transportation, such as scooters or car sharing services (Torrisi et al. 2021). Some state-of-the-art mobility studies, such as a study about e-scooters, analyze endogenous variables (e.g., the impact on transportation and urban planning) and exogenous variables (e.g., the impact on safety and the environment) to assess improvements in transportation services (Boglietti et al. 2021). Strategies and actions implemented at different scales can promote certain types of mobility and benefit specific user clusters, ranging from age groups to gender to different income brackets (Badii et al. 2022).

The literature focusing on the evolution of urban and transportation planning highlights certain correlations between transportation demand and supply under different scenarios. Several studies investigated the correlation of user characteristics and the propensity and knowledge of the concept of sustainable mobility (Moon 2021; Yang et al. 2021). In fact, some works correlate people's lifestyle and their practices, such as energy consumption (and carbon emissions) (Balest and Stawinoga 2022). Furthermore, technological developments and an increased propensity to reduce private vehicle use may incentivize different users to use more sustainable forms of mobility. A study focusing on the spread of car sharing in Berlin, Germany suggests that pro-technology identity and negative pro-car identity are significantly associated with the intention to participate in car sharing. The results suggest that to promote car sharing, regional governments should focus on attracting new users who already use mobility technologies (Derikx and van Lierop 2021).

Other studies focus on the psychology of behaviors; for example, energy-related behaviors that focus on social psychological influences on energy-related behaviors, including the role of identity and the testing of interventions aimed at change (Murtagh et al. 2012). Other works investigate the sociological aspect of lifestyles with a focus on the possibilities of lifestyle change (Levasseur et al. 2019). Some studies have examined different lifestyle scenarios, including pre–post pandemic, pre–post the advent of a transportation mode, pre–post the advent of a new fuel, etc. (Moraci et al. 2020). It is crucial in this time of severe crisis to also learn about contemporary transnational youth mobility, with particular attention paid to the intersections of migration, youth, and transition studies.

The Mediterranean model more generally highlights how mobility enables and shapes transitions that are simultaneously driven by economic imperatives and individual experiential desires and mediated by family and culture (Marchetti et al. 2022). Changing households over time also influences climate change requirements and the creation of new lifestyles and low-carbon practices. It is often emphasized that consumer perceptions of passenger vehicles are linked to a modus operandi according to rationalistic, instrumental, and predictable patterns. A better understanding of social and demographic perceptions of electric vehicles (compared to other forms of mobility, including conventional cars) was conducted by Sovacool et al. (2018) in Northern Europe by surveying about 5000 respondents in Denmark, Finland, Iceland, Norway, and Sweden.

Starting from the idea of wanting to study mobility dynamics in the city of Thessaloniki, Greece, the present work focuses on a data analysis acquired through a survey administration that detected the socio-economic attributes, travel choices, and self-determination aspects of the respondents as described in the next section.

3. Materials and Methods

3.1. Study Area

The study area is the larger urban zone of Thessaloniki, Greece. According to the recent census (2021), this area has a population of approximately one million inhabitants, which roughly corresponds to the 10% of the country's total population (Hellenic Statistical Agency (ELSTAT) 2021). Thessaloniki is the second largest city in Greece, and it has a high density of population, buildings, activities, and transport infrastructures. Across the largest cities in Greece, Thessaloniki has the highest proportion of female inhabitants (54.5%), while the average household size is 2.6 persons per household (Hellenic Statistical Agency (ELSTAT) 2014). The economically active population (15–60 years old) represents 74% of the total city's population, while the older age groups (over 60 years old) account for the 24% of Thessaloniki's residents (Politis et al. 2021a). Gross domestic product per capita, in current prices, is estimated at EUR 14,590, and the unemployment rate remains high (17.4%) as a consequence of the past financial crisis (Hellenic Statistical Agency (ELSTAT) 2022).

Traffic congestion, delays, and illegal parking are usual phenomena in the downtown area (Perra et al. 2017). In terms of air quality, Thessaloniki often scores very low when compared with other European cities (Eurostat 2021). In 2019, before the pandemic, the modal split of passenger transport in Thessaloniki was as follows: private car, 41.3%; public transport, 33.7%; walking, 9.2%; taxi, 3.0%; and cycling, 1.7% (Municipality of Thessaloniki (MoT) 2019). The car ownership rate is about 494 private cars per 1000 inhabitants (Hellenic Statistical Agency (ELSTAT) 2020), and car occupancy rates are below 1.5 persons per vehicle (Perra et al. 2017). Public transport is currently provided by buses only. The local public transport operator maintains a diesel bus fleet that includes a total of almost 600 mini, standard, and articulated vehicles. The public transport network, in general, has a radial shape with bus terminals which either facilitate transfers between bus lines or operate as intermodal hubs with private cars and suburban railway. There are over 70 bus lines which provide medium and high frequency fixed services along the arterial roads of the city and connections between the downtown area and the surrounding districts and suburbs. Smart technologies (i.e., e-ticketing, multimodal travel apps, etc.), along with the decarbonization of the diesel bus fleet, have not been adequately introduced, and passenger satisfaction is low (Papagiannakis et al. 2018). Thessaloniki will have its first underground metro line in 2023, and it is expected to improve the sustainability of the local urban transport system. This metro network, at its first phase, will only include 13 stations located along the city center's arterials and main streets. No established car-pooling, car-sharing, or ride-hailing transport schemes exist so far. Micro-mobility has a gradually increasing popularity, especially in the current post-pandemic period where an important share of travelers has discontinued public transport use (Tsavdari et al. 2022).

3.2. Data Collection and Overview

To meet our research objectives, an online questionnaire survey was designed and executed, and it was disseminated to the residents of the study area during March–May 2019 (Senikidou 2019). The survey form had closed-ended questions and included three (3) sections:

- First, respondents were asked to share some of their personal socioeconomic attributes, i.e., gender, age, monthly household income, and household size.
- The second part of the questionnaire sought to capture trip mode choice behavior of the survey participants. Specifically, they were asked to take into account the total number trips they performed during the previous month for all purposes, as well as the travel mode(s) they used. Based on these questions, they provided the average number of their trips per week and the distribution of these trips against a pre-determined set of travel modes, i.e., private car (as a driver or a passenger), motorcycle, public transport, bicycle, e-scooter, and walking. To avoid any misinterpretation, only trips that had a length of equal or more than 500 meters were recorded as trips made on foot. Furthermore, to ensure the homogeneity of responses and assist the survey

participants, the terms "trip" and "journey" were sufficiently explained in a text field of the survey form.

- The third part of the questionnaire pertained to the self-determination aspects of respondents. It included nine (9) questions that were answered on a 5-point Likert scale (ranging from strongly disagree to strongly agree). For each of these questions, participants had to express their level of agreement toward statements which were expressed as follows: "*I consider my self being . . .* ". Overall, we investigated nine (9) self-identity items based on the literature review we performed and the local setting. All identity items were defined and explained in accompanying text fields in the survey form. Specifically:
  - The designation "Urban resident" controlled whether the individuals felt they were integral parts of or sufficiently familiar with the environment in which they resided.
  - Respect for the physical environment and the level of engagement with it were examined with the self-identity items of "Environmentally friendly" and "Nature-lover", respectively.
  - The importance of family and personal relationships in the lives of the individuals were captured with the characterizations of "Parent" and "Companionate".
  - The "Sporty" identity highlighted those who performed physical activities more or less frequently.
  - In the case of "Healthy", participants self-reported their own estimation regarding whether they were healthy enough according to personal and generally accepted criteria.
  - "Career-oriented" was selected to identify people who devoted a significant part of their lives to carrying out their professional duties or who were ambitious regarding the progress of their careers.
  - Creativity, inventiveness, and ingenuity were associated with the designation of "Innovative" for people who considered themselves as possessing these traits.

After removing any incomplete survey forms with missing fields or inconsistent answers from our dataset, we ended up with a sample of 506 completed responses.

Table 1 shows the variables we extracted from our questionnaire survey and categorizes them into three (3) groups: socioeconomic, trip mode choice, and self-identity characteristics.

Table 1 shows that most of the respondents are female (63.4%) and belong to a household that has 1 or 2 members (56.2%). Characteristics related to the local socioeconomic conditions are described in Section 3.1. We did not obtain enough answers from people over 55 years old, possibly due to the fact that the survey was made available online (Politis et al. 2021b). All income categories are satisfactorily represented in our sample, while most of the individuals are concentrated between EUR 401 and EUR 1600 per month.

Overall, the survey respondents appear to have a moderate mobility rate. Most of them are performing up to 30 trips per week (86.3%), with 11–20 trips per week by all modes (43.1%). Regarding trip mode choices, we observe that our sample is generally divided between people who do not drive a passenger car at all (43.9%) and people who state either a less (28.1%) or more frequent use (28%) of private cars as drivers. More than half of the survey participants (51%) answered that either they do not travel as car passengers at all or they travel as passengers less than one time per week. This is probably a finding that confirms the evidence of low car occupancy rates in Thessaloniki and the absence of any organized car-pooling or ride-hailing scheme.

However, most of the respondents (64.8%) have access to private car trips, either as drivers or passengers. When it comes to public transport use, we observe a variety of trip frequency rates. An important share of our sample (31.2%) travels by public transport daily, while an almost equal share (30.8%) does not use public transport modes or rarely performs any public transport trip. Many respondents (48%) answered that they perform trips on foot daily. Very few trips were recorded for motorcycle, bicycle, and e-scooter modes.

Table 1. Socioeconomic, trip mode choice, and self-identity variables of survey respondents.

	Variable	Options	N	%
Socioeconomic attributes	Gender	Male	185	36.6%
		Female	321	63.4%
	Age	18–24 years old	140	27.7%
		25–39 years old	222	43.9%
		40–54 years old	106	20.9%
		55–65 years old	38	7.5%
	Monthly household income (euros)	0–400	97	19.2%
		401–800	92	18.2%
		801–1200	115	22.7%
		1201–1600	75	14.8%
		1601–2000	61	12.1%
		More than 2000	66	13.0%
	Household size	1–2 members	284	56.2%
		2–4 members	207	41.0%
		5 or more members	14	2.8%
Trip mode choices	Access to private car	Yes	328	64.8%
		No	178	35.2%
	Number of trips per week	0–10	115	22.9%
		11–20	217	43.1%
		21–30	102	20.3%
		31–40	43	8.5%
		More than 40	26	5.2%
	Number of trips by car (as a driver) per week	0	222	43.9%
		<1	50	9.9%
		1–3	92	18.2%
		4–7	53	10.5%
		>7	89	17.5%
	Number of trips by bicycle per week	0	390	77.1%
		<1	54	10.7%
		1–3	39	7.6%
		4–7	10	2.0%
		>7	13	2.6%
	Number of trips by public transport per week	0	69	13.6%
		<1	87	17.2%
		1–3	135	26.8%
		4–7	57	11.3%
		>7	158	31.2%
	Number of trips by car (as a passenger) per week	0	105	20.8%
		<1	153	30.2%
		1–3	200	39.5%
		4–7	24	4.7%
		>7	24	4.7%
	Number of trips on foot per week	0	7	1.4%
		<1	26	5.1%
		1–3	142	28.1%
		4–7	88	17.4%
		>7	243	48.0%

Table 1. *Cont.*

	Variable	Options	N	%
	Number of trips by motorcycle per week	0	446	88.1%
		<1	14	2.8%
		1–3	23	4.5%
		4–7	2	0.4%
		>7	21	4.2%
	Number of trips by e-scooter per week	0	440	87.0%
		<1	38	7.5%
		1–3	25	5.0%
		4–7	1	0.2%
		>7	2	0.4%
Self-identity items	Urban resident	Strongly disagree	14	2.8%
		Disagree	18	3.6%
		Neutral	29	5.7%
		Agree	60	11.9%
		Strongly agree	385	76.1%
	Nature lover	Strongly disagree	16	3.2%
		Disagree	45	8.9%
		Neutral	92	18.2%
		Agree	107	21.1%
		Strongly agree	246	48.6%
	Parent	Strongly disagree	334	66.0%
		Disagree	13	2.6%
		Neutral	24	4.7%
		Agree	10	2.0%
		Strongly agree	125	24.7%
	Companionate	Strongly disagree	17	3.4%
		Disagree	29	5.7%
		Neutral	58	11.5%
		Agree	105	20.8%
		Strongly agree	297	58.7%
	Environmentally friendly	Strongly disagree	19	3.8%
		Disagree	37	7.3%
		Neutral	90	17.8%
		Agree	167	33.0%
		Strongly agree	193	38.1%
	Healthy	Strongly disagree	4	0.8%
		Disagree	16	3.2%
		Neutral	62	12.3%
		Agree	151	29.8%
		Strongly agree	273	54.0%
	Sporty	Strongly disagree	91	18.0%
		Disagree	93	18.4%
		Neutral	105	20.8%
		Agree	114	22.5%
		Strongly agree	103	20.4%

Table 1. *Cont.*

Variable	Options	N	%
Career-oriented	Strongly disagree	21	4.2%
	Disagree	34	6.7%
	Neutral	91	18.0%
	Agree	142	28.1%
	Strongly agree	218	43.1%
Innovative	Strongly disagree	39	7.7%
	Disagree	72	14.2%
	Neutral	107	21.1%
	Agree	158	31.2%
	Strongly agree	130	25.7%

Concerning the self-identities reported in Table 1, almost all survey participants (88%) feel that they fit the characterization of "Urban resident". Very high and roughly equal proportions of individuals stated that they are "Environmentally friendly" (71%) and "Nature-lovers" (69.7%). Only approximately one out of four people (26.7%) is affiliated with the "Parent" identity. For the "Sporty" identity item, we observe that the survey participants hold a variety of opinions, and they are almost equally distributed among the scale categories. The self-identity items of "Companionate", "Career-oriented", and "Innovative" concentrated considerable shares of individuals who may adopt them as personal attributes.

3.3. Data Analysis

We followed a two-step approach to analyze our data. First, we employed Latent Class Analysis (LCA) as a dimension reduction mechanism that aimed to identify mutually exclusive clusters of survey respondents who could be characterized using an overarching self-identity label. In fact, LCA seeks to create a statistical model which arranges the actual classification pattern of observed (manifest) variables under an unobserved (latent) nominal variable that removes any confounding between the manifest variables (Linzer and Lewis 2011). Therefore, the LCA model probabilistically assigns each observation in an exclusive cluster (latent class) and provides a segmentation of the initial dataset of manifest variables. This clustering also indicates how each observation will respond against the observed manifest variables (Linzer and Lewis 2011). The following equation (1) describes the basic LCA model, which estimates the probability P for a nth observation y (y_n) of a manifest variable to belong to a latent class j, given s latent classes, the prior probability of membership in class j (π_j), and the class specific probability P_j of y_n under the class specific parameters θ_j (Haughton et al. 2009).

$$P(y_n|\theta) = \sum_{1}^{s} \pi_j P_j(y_n|\theta_j) \quad (1)$$

For this study, the manifest variables include the nine (9) self-identity variables mentioned in Table 1. To determine more meaningful and robust latent classes, we converted these manifest variables into nine (9) respective dichotomous variables, i.e., the individuals were categorized into "Agree" and "Disagree" groups. Therefore, for each manifest variable, the "Agree" category included all of those who selected "Agree" and "Strongly Agree" as well as those individuals who answered "Neutral" and later in the clarifying questions of the survey form answered that they "would probably agree" with the self-identity item under examination. *Mutatis mutandis*, the "Disagree" category was derived. We used the Polytomous Variable Latent Class Analysis (poLCA) package (Linzer and Lewis 2016) of R software (R Core Team 2013) to run the LCA. To select the most appropriate LCA

model (i.e., the number of latent classes), we considered specific goodness of fit criteria that included the Bayesian Information Criterion (BIC) (Schwartz 1978), Akaike Information Criterion (AIC) (Akaike 1998), Pearson's χ^2 goodness of fit, and likelihood ratio chi-square (G^2) statistical measures (Goodman 1970). These statistics are automatically produced by poLCA software, and the objective is to minimize their value in order to determine the most preferred LCA model.

Secondly, to discover whether the self-declared identity items of individuals are associated with their trip mode choice behavior, we performed Pearson's chi-square test analyses. This decision was guided by the fact that our dataset (Table 1) contained only nominal or ordinal variables. Specifically, the latent variable served as the dependent variable for these tests and informed the j class where each individual was probabilistically assigned according to the LCA results. The independent variables were the trip mode choice variables mentioned in Table 1. To further understand the latent classes' composition, we also considered the socioeconomic attributes discussed in Table 1 as independent variables against the latent one. In all Pearson's chi-square tests we performed, the null hypothesis (H_0) assumed no relationship between the latent variable and the trip mode choice or socioeconomic attributes. The alternative hypothesis (H_1) indicated a statistically significant association between them. The H_0 hypotheses were rejected when *p*-values were lower than 0.05. The analyses of this second step were carried out using SPSS software (IBM Corp 2017).

4. Results and Discussion

4.1. Latent Class Profiles

We ran LCA examining models with s = 2, 3, and 4 latent classes and obtained the following results for the above-described goodness of fit criteria (Table 2). The model with two classes had the lowest BIC value, while the model with four classes seemed to perform better regarding the other three criteria. Since there is not a commonly accepted criterion for selecting the most appropriate LCA model, we also had to also consider the interpretability of each model under examination (Nylund et al. 2007; Zhang et al. 2018). In this respect, the model with the three classes, which stands between the two other models in terms of goodness of fit statistics, provides the strongest conceptual characteristics.

Table 2. Statistics that assess LCA models' goodness of fit for various s classes.

Goodness of Fit Criteria	s = 2	s = 3	s = 4
AIC	4927.39	4902.003	4876.725
BIC	5007.694	5024.572	5041.56
X^2	392.2224	346.8351	301.5569
G^2	502.035	483.7198	408.1155

Table 3 presents the full output from the estimation of the three-class LCA model. Each row corresponds to a class and a manifest variable. For each manifest variable, the figures in the two last columns denote the class specific probabilities P_j that the observations agree/disagree belong to each of the three latent classes. Therefore, an individual belonging to Class 1 has an 88.53% chance to agree with the designation "Urban resident" and a 11.47% chance to disagree.

Table 3 shows that all Class 1 members (100%) describe themselves as "Healthy", while an important percentage of them (75.42%) also agree with the "Sporty" identification. Class 2 and Class 3 members are more likely to not characterize themselves as "Sporty" (78.27% and 84.88%, respectively). Class 2 is predominantly characterized by people who consider themselves "Companionate" (100%) and "Parent" (77.96%). In practice, "Parent" is a key trait for the labelling of this Class since the other two Classes (1 and 3) have small percentages of individuals who are likely to self-determinate as parents (1.14% and 17.40%). Both Class 1 and Class 2 members share common characteristics that relate to "Urban resident", "Nature-lover", "Environmentally friendly", "Career-oriented", and

"Innovative". In order to select labels for these two Classes, we took into account their most determining attributes. Thus, for Class 1 members, we used the term "Active", which combines "Healthy" and "Sporty" self-identity items, while for Class 2, we selected the label of "Family-Oriented", which represents both "Parent" and "Companionate" aspects.

Table 3. Three-Class Latent Model results. Conditional item response probabilities by self-identity (manifest) variable per Class.

Manifest Variable	Latent Class	Probability (Disagree)	Probability (Agree)
Urban resident	1	0.1147	0.8853
	2	0.0841	0.9159
	3	0.1142	0.8558
Nature lover	1	0.1416	0.8584
	2	0.0923	0.9077
	3	0.5284	0.4716
Parent	1	0.9886	0.0114
	2	0.2204	0.7796
	3	0.8260	0.1740
Companionate	1	0.2434	0.7566
	2	0.0000	1.0000
	3	0.2884	0.7116
Environmentally friendly	1	0.1033	0.8967
	2	0.0231	0.9796
	3	0.5614	0.4386
Healthy	1	0.0000	1.0000
	2	0.0816	0.9184
	3	0.3198	0.6802
Sporty	1	0.2458	0.7542
	2	0.7827	0.3173
	3	0.8488	0.1512
Career-oriented	1	0.1841	0.8159
	2	0.0916	0.9084
	3	0.4676	0.5324
Innovative	1	0.2884	0.7116
	2	0.1877	0.8123
	3	0.6615	0.3385

The labelling of Class 3 is a comparatively more complicated case. The vast majority of Class 3 members did not find themselves affiliated with the self-determination aspects of "Sporty" (84.88%) and "Parent" (82.60%), which mainly identify Class 1 and Class 2 participants. Important percentages of people who feel "Companionate" (71.16%) and "Healthy" (68.02%) belong to this Class. Furthermore, Class 3 combines almost equal shares of respondents who identify themselves as "Nature-lovers", "Environmentally friendly", and "Career-oriented". Additionally, as with all other Classes, Class 3 mainly consists of "Urban residents" (85.58%). Considering these results, we may argue that, in general, Class 3 individuals are not "Active" (Class 1) or "Family-Oriented" (Class 2) as they share varying views regarding issues such as ecology, health, companionship, nature, innovation, and career pursuits, and at the same time, almost all of them self-identify as "Urban residents". Therefore, due to this diversity, we label Class 3 members as being "Typical Urban".

Based on the above, our latent variable has three unordered categories: Active (Class 1), Family Oriented (Class 2), and Typical Urban (Class 3). The distribution of the sample's population in the three Classes is shown in Figure 1, where taller bars indicate a higher conditional probability of an individual who agrees with a self-identity item to belong to each Class. Therefore, 31.59% (N = 160) of the survey participants may be characterized

as Active (Class 1), while 23.81% (N = 120) of them are Family-Oriented (Class 2), and the other 44.6% (N = 226) are Typical Urban (Class 3).

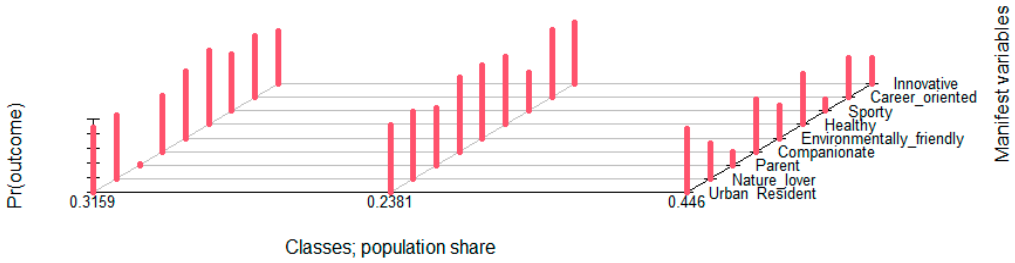

Figure 1. Latent classes' population shares and class-conditional response probabilities.

4.2. Socioeconomic Composition

To gain a deeper insight into the socioeconomic composition of each latent class population, we performed four chi-square tests of association, as explained in Section 3.3. We performed this analysis without accounting for survey respondents who are "55–65 years old" and live in a household of "5 and more members" because there were very few respondents in these categories which would prevent chi-square tests from functioning properly and returning valid outputs (Table 1).

Regarding age, the chi-square test results enabled us to reject the null hypothesis (H_0), highlighting a statistically significant association ($\chi(1) = 86.258$, p-value < 0.001) between age and our latent variable. This association is illustrated in Figure 2a, which shows that the Active class concentrates a comparatively younger population than the Family-Oriented one. The latter is primarily based on individuals who are between 40–54 years old (62.2%). In contrast, almost half of the Typical Urban individuals (49.1%) belong to the 25–39 years old category. Typical Urban and Active individuals seem to follow very similar age characteristics.

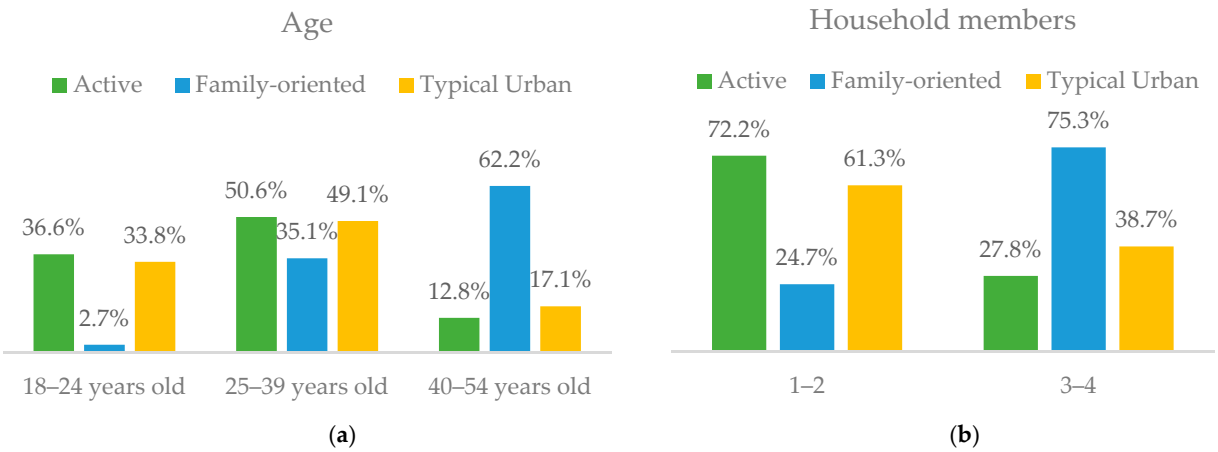

Figure 2. Distribution of latent classes' population against categories of (**a**) age and (**b**) household size.

Figure 2b depicts the statistically significant association ($\chi(1) = 58.972$, p-value < 0.001) we found between household size and the latent class variable. As expected, a Family-Oriented individual is more likely to live in a household with 3–4 people (75.3%), while an Active class member is more likely to live in a household with 1–2 people (72.2%). The Typical Urban population is comparatively more evenly distributed against the two studied household size categories.

In the case of monthly household income, the chi-square test also demonstrated a statistically significant association with the latent variable ($\chi(1) = 49.502$, p-value < 0.001). Figure 3 helps explain this result since it shows that the 67% of Family-Oriented members

earn more than EUR 1201 per month in their households, while the 72.9% of Active members earn less than EUR 1201 correspondingly. The Typical Urban individuals represent considerable shares in all the income categories of Figure 3.

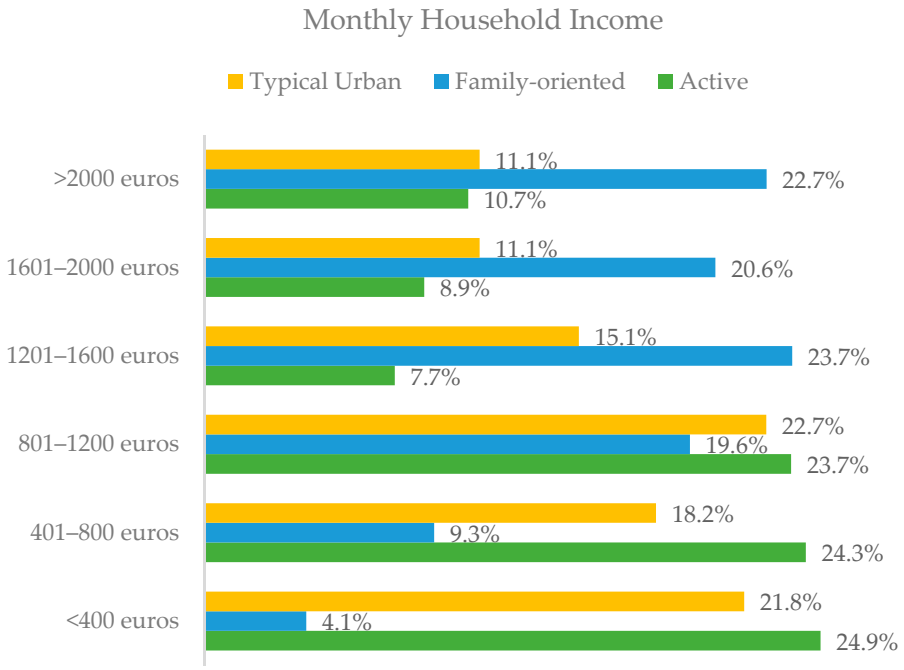

Figure 3. Distribution of latent classes' population against categories of monthly household income.

Gender is the only independent variable that did not demonstrate a statistically significant association with our latent variable.

4.3. Association with Trip Mode Choice Behavior

The chi-square test results indicated that the gross travel activity (number of trips per week by all modes) of the examined individuals is independent from their latent characteristics ($\chi(1) = 4.761$, p-value = 0.783). However, the Family-Oriented group has comparatively greater access to private car trips (as drivers and/or passengers). This statistically important relationship ($\chi(1) = 4.761$, p-value = 0.783) is illustrated in Figure 4.

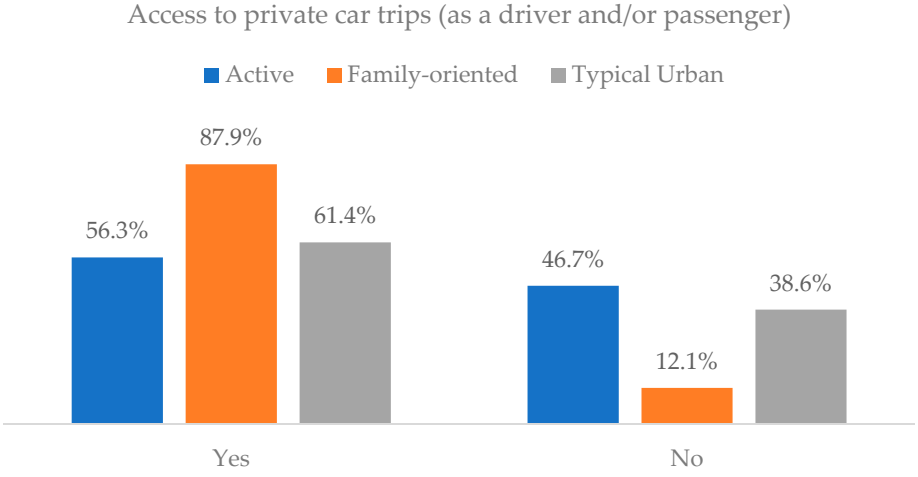

Figure 4. Distribution of latent classes' population against the availability of private car trips.

Figure 5 further confirms this fact and demonstrates the statistically significant associations we discovered for: (a) trip frequency by car (as a driver) and the latent variable

($\chi(1) = 48.683$, p-value < 0.001) as well as for (b) trip frequency by public transport and the latent variable ($\chi(1) = 33.027$, p-value < 0.001). Overall, we observe that private car use (as drivers) is a comparatively more frequent travel option among Family-Oriented individuals, while public transport is particularly favored among the Active and Typical Urban representatives. Typical Urban individuals demonstrate a similar trip mode choice behavior as the Active ones, but they have slightly higher trip frequencies by car (as drivers) and by public transport.

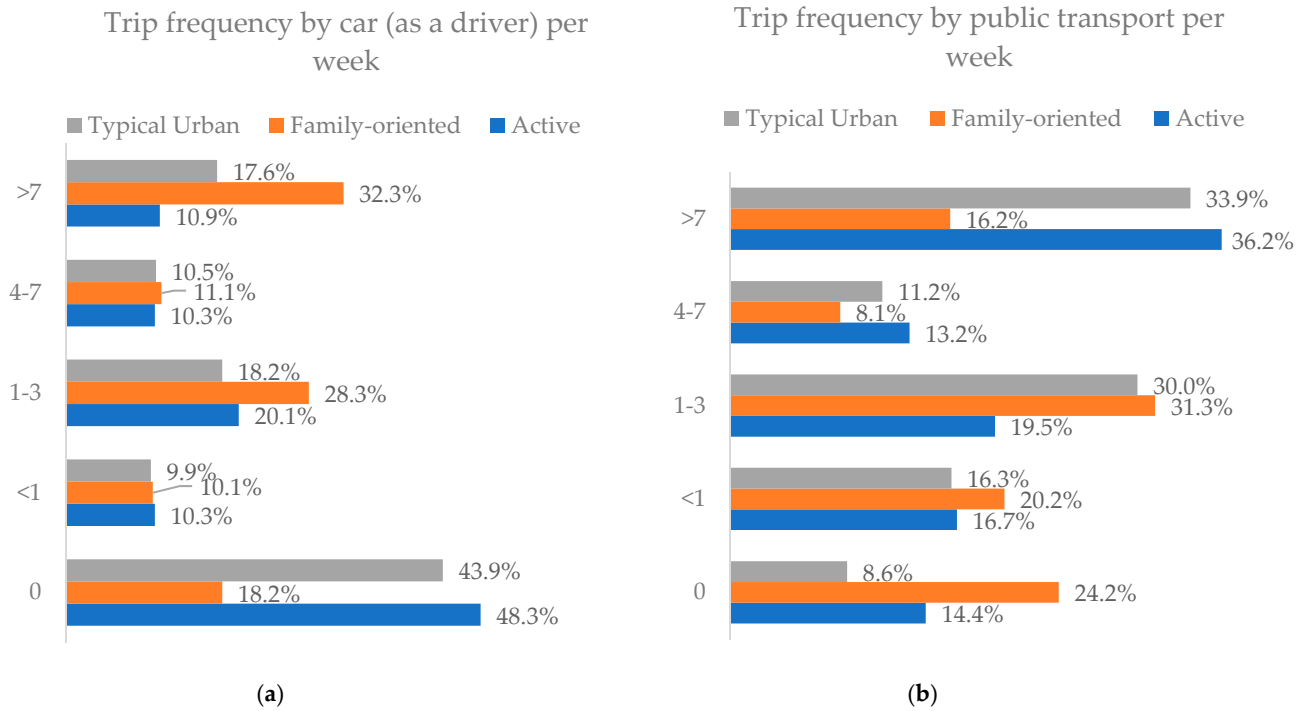

Figure 5. Distribution of latent classes' population against categories, including (**a**) trip frequency by car (as a driver) and (**b**) trip frequency by public transport.

Specifically, Figure 5a shows that the 32.3% of the Family-Oriented individuals drive a car daily, and 18.2% of them do not drive a car at all. A roughly opposite figure applies to the Active group as 10.9% of them are daily car drivers and 48.3% are non-car drivers. Regarding the other categories of trip frequencies by car (Figure 5a), we do not observe such sharp differences between the Family-Oriented and the Active. Typical Urban individuals demonstrate similar car trip frequency behavior (as drivers) as Active ones, but they have a slightly larger rate of use.

For public transport, Figure 5b indicates that 36.2% of the Active group travels by public transport modes daily, while the respective share among the Family-Oriented is 16.2%. As expected, the percentage of Family-Oriented individuals who do not use public transport (24.2%) is greater than Active (14.4%) and Typical Urban (8.6%) class members. However, we observe an important share (31.3%) of Family-Oriented members who use public transport 1–3 times per week. Regarding the Typical Urban class, a greater variety of trip frequency behavior is observed. Among the Typical Urban group, 33.9% of the individuals travel by public transport daily, and 30% of them use public transport 1–3 times per week. Only a small percentage (8.6%) of Typical Urban individuals do not travel by public transport.

Concerning the trips made on foot and the trips by car (as passengers), we were not able to reject the null hypothesis (H_0) for the chi-square tests we carried out. This means that Active, Family-Oriented, and Typical Urban individuals equally prefer travelling on foot and by car as passengers.

Finally, because only small percentages of the survey respondents reported trips by motorcycle, bicycle, and e-scooters (Table 1), we did not examine such travel modes under this analysis framework.

5. Conclusions

This study examined the role of personal identity attributes in trip mode choice during the late pre-pandemic period. The study area was Thessaloniki, Greece, which is an urban area with approximately one million inhabitants. We collected relevant questionnaire survey data from 506 residents who reported their socioeconomic characteristics, their trip frequencies by each available transport mode, as well as the degree of their affiliation with nine (9) specific self-identity items. We ran LCA to define clusters of individuals who could be characterized by prevailing and unobserved self-determination aspects. Statistical inferential techniques helped us investigate the composition of these clusters along with their travel mode choice behaviors.

Our analyses' results indicated three (3) latent classes of individuals within our sample, including Active, Family-Oriented, and Typical Urban. In general, the Active individuals self-determinate as sporty and healthy and they are mostly young and single and belong to medium or low-income categories. The Family-Oriented representatives consider themselves as companionate and parent and they have families and earn medium to high incomes. Typical Urban is a more diverse group that incorporates a greater variety of socioeconomic and personal identity items. Access to a private car is comparatively higher among the Family-Oriented individuals. In the same context, using a private car (as drivers) is particularly favored among the Family-Oriented people, while public transport is more popular among the Active and Typical Urban classes. Trips on foot and by car (as passengers) are equally preferred by all latent classes' populations.

These empirical findings demonstrate that the Family-Oriented lifestyle is importantly associated with private car use (as drivers), while public transport is more appealing to younger, lower-income, and sporty individuals who have little access to private cars. To increase ridership, local public transport planning should sufficiently recognize and incorporate Family-Oriented travel needs. This process should include customized marketing campaigns and quality-of-service improvement measures that might refer, inter alia, to tailored fare policies (e.g., family tickets), greater spatial and temporal accessibility to critical education and leisure destinations, upgraded safety and security measures at stops and on-board, etc. Such measures would also be beneficial for the creation of efficient and sustainable MaaS schemes as public transport is always a key component of integrated transport systems and services.

In this study, we were not able to adequately study the relationships between personal identities and trip mode choices regarding e-scooters, bicycles, and motorcycles. The respective modal shares are low in the case of Thessaloniki; therefore, our sample did not include enough micro-mobility users. Future research may investigate the impact of the COVID-19 pandemic on trip mode choices associated with contemporary personal identity characteristics as these have possibly changed due to the pandemic.

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