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Sustainable transport modes, travel satisfaction, and emotions: Evidence from car-dependent compact cities

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ABSTRACT

This study investigates how the use of sustainable transport modes relates to travel satisfaction (general evaluation of travel) and travel affect (emotions during travel) in car-dependent compact cities. Thereby, the study provides evidence on sustainable mobility and travel-related well-being in a context of compact urban form but inadequate provisions for public transport, walking, and cycling. A mixed-methods approach was applied comprising quantitative and qualitative analyses of data from the two major cities of Greece, i.e., Athens and Thessaloniki. Travel satisfaction and travel affect are found to be highest for those who walk for commuting, independently of travel time and other factors. Conversely, travel satisfaction and travel affect are lowest for public transport users, largely due to very long travel times but also poor public transport services in one of the two cities. Results indicate that the experience of traveling by public transport, car, and motorcycle within urban areas greatly depends on transport provision and policies. Overall, findings support the idea that to shift to pleasant, satisfying, and sustainable mobility in car-dependent compact cities, car restrictions should be accompanied by massive improvements in public transport, high-quality walking and cycling infrastructure, and an integrated coordination of different modes.

1. Introduction

Travel satisfaction is an important indicator of urban livability as it is associated with higher subjective well-being (De Vos, 2019; Mouratidis, 2020; Olsson et al., 2013). Several studies have investigated how transport modes contribute to travel satisfaction and found that the transport mode one uses is a key determinant of travel satisfaction in cities (De Vos et al., 2016; Friman et al., 2017; Lancée et al., 2017; St-Louis et al., 2014). However, this relationship has not been sufficiently explored in cities of high-density urban form accompanied by problematic public transport systems, insufficient car restrictions, and poor infrastructure for walking and cycling. Cities with such characteristics – called here "car-dependent compact cities" – may offer short distances to destinations but do not satisfy other criteria of the compact city model such as high degrees of walkability, bikeability, and accessibility by public transport (Mouratidis, 2018, 2022b; Neuman, 2005). Car-dependent compact cities are commonly found worldwide, although the degree of car dependency and insufficient provision for sustainable mobility may of course vary. How people experience the use of different transport modes in such cities may differ from what is known from previous studies. Exploring the relationship between transport modes (and particularly sustainable transport modes) and travel-related well-being (travel satisfaction and travel affect) in this context can offer useful knowledge when shaping sustainable urban transport strategies and policies in car-dependent compact cities.

The main aim of this study is to explore how different transport modes relate to travel satisfaction (general evaluation of travel) and travel affect (emotions during travel) in car-dependent compact cities. We primarily aim to understand whether travel experience and satisfaction of users of sustainable transport modes (active travel and public transport) may differ in such a context. We analyze travel satisfaction and travel affect in two Greek cities, i.e., Athens and Thessaloniki. The two cities belong to a wider region, i.e., Southern Europe, which has often been overlooked by travel behavior and travel satisfaction studies.

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Both cities are characterized by high densities and mixed uses but, while their public transport services are considerably different, they are both still dominated by car use. Thus, these cities offer plenty of material to explore travel satisfaction and travel affect in relation to sustainable mobility in a context which bears many features of sustainable urban form but with unsustainable transport provision and modal share.

The study is based on a mixed-methods approach combining quantitative and qualitative analyses. This approach, which is quite unique in travel satisfaction studies (see also Mouratidis et al., 2019), is very useful for understanding both trends in travel satisfaction (quantitative data) but also the role of the local context in shaping these trends (qualitative data). In the quantitative analysis, we examine both travel satisfaction and travel affect. Travel satisfaction is a cognitive measure assessing the level of overall contentment with travel, while travel affect is an affective measure assessing the emotions experienced during travel. Both are important measures of travel-related well-being, and they may contribute to overall subjective well-being (Lancée et al., 2017; Mouratidis, 2020; Singleton, 2019).

In sum, the paper's contribution is threefold. (1) The paper provides new evidence on travel satisfaction and travel affect in car-dependent compact cities; a context that has been overlooked by previous research. Such a context could substantially influence travel experience and subsequently have an impact on cities' efforts towards sustainable mobility. (2) Travel satisfaction and travel affect are studied here in two different cities, when most relevant studies focus only on one city. Analyzing data from two cities in the same study offers more insight into the role of the local context – including factors such as transport infrastructure, transport policies, urban form, and city size – in travel-related well-being. (3) Considering the global climate crisis and urban sustainability in general, we attempt to shift the focus of studies on travel experience and satisfaction towards the link between travel-related well-being and sustainable mobility.

The remainder of this paper is organized as follows. Section 2 describes the case areas, Section 3 presents the data collection and data analysis methods, Section 4 reports the results, while Section 5 provides a discussion and conclusions.

2. Literature review

2.1. Predictors of travel satisfaction

Mainly since 2010, many travel behavior studies have focused on how people experience their travel and how satisfied they are with it (Chatterjee et al., 2020; De Vos et al., 2013; Mokhtarian, 2019). Many of these studies deal with the effects of the chosen travel mode on travel satisfaction. Anable and Gatersleben (2005) were the first to analyze these effects, indicating that active travelers in the UK were more relaxed and less stressed compared to people using motorized travel modes. By using the self-developed Satisfaction with Travel Scale (STS), studies in Sweden (e.g., Ettema et al., 2011; Olsson et al., 2013) found that people walking and cycling are most satisfied with their travel, while public transport users are least satisfied. These outcomes were later confirmed by studies using this scale in other countries (e.g., De Vos et al. (2016) in Belgium; Ye and Titheridge (2017) in China; and Singleton (2019) and Smith (2017) in the US), studies using agreement ratings on statements on travel satisfaction (e.g., Bergstad et al., 2011; St-Louis et al., 2014; Zhu & Fan, 2018a), and studies using data from national time use surveys (Morris & Guerra, 2015; Zhu & Fan, 2018b).

Despite an overall agreement in results, some studies found some deviating outcomes. Several studies found that public transport use may be more enjoyable than car use, especially when rail-based public transport is used (e.g., train or light-rail) (Duarte et al., 2010; Handy & Thigpen, 2019; Mokhtarian et al., 2015; Mouratidis et al., 2019; Smith, 2017; St-Louis et al., 2014). Moreover, a study from Montreal, Canada found that car driving is the most stressful mode of commuting (Legrain et al., 2015). Zhu and Fan (2018a) even found that people using the employer shuttle buses are more satisfied than people walking and cycling (possible because of social interaction with co-workers). Interestingly, three Chinese studies found that people using e-bikes are relatively dissatisfied with their travel (potentially due to conflicts between e-bike users and other road users), considerably less satisfied compared to people using traditional bikes (Ye & Titheridge, 2017, 2019; Zhu & Fan, 2018a), while a Dutch study in contrast found that e-cyclist are more satisfied than drivers (de Kruijf et al., 2019). Very few studies have focused on satisfaction with motorcyclists, despite the motorcycle being an important travel mode in certain regions (e.g., Asia, Southern Europe, Central America). Although many studies have found significant influence of the chosen travel mode on travel satisfaction, this effect may be partly explained by differences in travel duration by travel mode. De Vos et al. (2022) and Lades et al. (2020) indicate that active travel is more satisfying than motorized travel since active trips mostly have shorter durations than trips by motorized modes.

Besides effects of travel mode on travel satisfaction, studies from different geographical contexts found that travel duration has a negative impact on travel satisfaction (e.g., Morris & Guerra, 2015; Zhu & Fan, 2018a,b). Furthermore, studies have found that a positive attitude towards the chosen travel mode and being able to travel with the preferred mode have a positive impact on satisfaction levels (De Vos, 2018; Mokhtarian et al., 2015; St-Louis et al., 2014; Ye and Titheridge, 2019). Studies analyzing the impact of the built environment on travel satisfaction have not yet reached a consensus. While Ye and Titheridge (2017) did not find significant effects of built environment characteristics on travel satisfaction in China, Mokhtarian et al. (2015) found that urban residents in France find traveling less tiring, but also less pleasant, compared to suburban and rural residents, respectively. De Vos and Witlox (2016) found that Belgian suburban residents were somewhat more satisfied with travel compared to urban residents, but that these differences were mainly explained by a higher share of older adults living in suburban areas, who tend to be more satisfied. In a more recent study from Belgium, De Vos et al. (2021) found that urban residents are more satisfied with travel compared to suburban residents, but only for leisure trips. Finally, in Norway, Mouratidis et al. (2019) found that density and distance to city center have no direct effect on travel satisfaction, but strong indirect effects through trip duration and travel mode choice. They specifically found that high density and inner-city residential locations contribute to higher travel satisfaction by enabling shorter travel times and more walking and cycling (Mouratidis et al., 2019).

Most studies analyzing travel satisfaction over the past years originate from Western and Northern Europe, and North America. These studies often use data from relatively small (European) cities with good public transport and cycling facilities (e.g., in Sweden (Bergstad et al., 2011; Friman et al., 2017; Olsson et al., 2013), Belgium (De Vos, 2019; De Vos et al., 2016; De Vos et al., 2019), Norway (Mouratidis, 2020; Mouratidis et al., 2019), and the Netherlands (de Kruijf et al., 2019; Ettema et al., 2013)), North-American cities with low densities (Singleton, 2019; Smith, 2017), or use small or biased samples (e.g., of university staff and/or students (Ettema et al., 2011; Legrain et al., 2015; Páez & Whalen, 2010; St-Louis et al., 2014; Willis et al., 2013)). Studies performed in major Chinese cities, for instance, found somewhat deviating outcomes, e.g., high satisfaction levels with employer-provided buses and low satisfaction levels of e-bike users (Ye & Titheridge, 2017, 2019; Zhu & Fan, 2018a). Furthermore, Swedish studies indicated that travel behavior and travel satisfaction may even differ between cities within one country (i.e., Stockholm, Gothenburg and Malmö (Ettema et al., 2012; Friman et al., 2013)), while Maheshwari et al. (2022) – analyzing data from 32 European countries – found that satisfaction with commuting time significantly differs by country. All these suggest that the travel context may play a bigger role in (the effect of travel mode on) travel satisfaction than often assumed. Many urban contexts (e.g., car-dependent and high-density cities) and travel modes not often used in Western countries (e.g., motorcycles) are often

overlooked in travel satisfaction studies. A focus on these contexts may consequently provide valuable insights into how travel modes affect the experience of travel.

2.2. Case areas: Urban form, transport infrastructure, and travel behavior

Following an overview of travel satisfaction literature and before presenting our results, it is important to provide a brief profile of the distinctive features of urban form and transport infrastructure and outline recent research findings regarding travel behavior in the two cities that this study focuses on.

Athens and Thessaloniki are the two largest cities in Greece. Greater Athens, which represents the continuous urban area of Athens, has a population of 3.1 million people. Its wider metropolitan area, Attica Region, reaches a population of 3.8 million, accounting for 35% of the country's population. The population of Thessaloniki's urban continuous and compact part is inhabited by 0.8 million people, while its metropolitan area (Thessaloniki Peripheral Unit) has a population of 1.1 million people.

The compact and cohesive parts of both cities are today characterized by high population density and mixed uses (Chorianopoulos et al., 2010; Mouratidis & Yiannakou, 2022) especially along the main road axes but also within neighborhoods. This compact and mixed-use pattern was formed as a result of two main factors: (i) the dominant system of development within the cohesive parts of both cities with intensive building regulations per plot and provision of shops on the ground floors (Yiannakou, 1993); and (ii) the fact that development occurred on the basis of a street layout plan either with no special land use regulations in the older parts of the cities, or, in the newer ones, based on land use regulations which, in the Greek planning system, favor mixed uses by allowing important amenities and services for daily needs even within purely residential areas.

The two cities of course differ in many respects. Certain middle- and high-income residential districts in Athens operate more as purely residential areas with less mixed uses but with dynamic local centers. In Thessaloniki, which is a much smaller city, the spread of mixed uses is more intense even in typical middle-class districts. Residential sprawl, a phenomenon that was intensified in the two decades before the economic crisis of the 2010s occurred in the most accessible suburbs as well as in areas outside the planned parts of these suburbs. These spatial patterns reflect the specificity of Mediterranean urbanization compared to the development paths prevailing in Western and Northern European cities (Salvati & Venanzoni, 2017).

The two cities differ drastically in terms of public transport provision. Athens has a public transport system comprised of various modes (metro, buses, trolleybuses, tram, suburban rail) which was integrated in the first half of the 2000s as part of the Athens 2004 Olympic Games public works. However, important deficiencies in public transport services together with lack of restrictions on car use often make the car the more attractive travel option in Athens. In Thessaloniki, the public transport system is based exclusively on an urban bus network (Tyrinopoulos & Antoniou, 2008). Public transport density is lower in Thessaloniki than in Athens (Mouratidis & Yiannakou, 2022). Thessaloniki metro, expected to operate by the end of 2023, has been under construction for a very long time, an issue that led to a mistrust of the inhabitants regarding public transport policy. As in the case of Athens, measures directly aiming to discourage and reduce car use (e.g., removal of street parking, car-free zones, congestion charges, multi-modal street design) in Thessaloniki are almost non-existent. Both cities lack integrated walking and cycling networks. The low level of public transport service, the lack of car restrictions, as well as the lack of infrastructure for soft mobility in the two cities have a significant impact on travel behavior and satisfaction.

Modal split surveys indicate strong evidence of car-dependent behavior, since car trips represent more than 50% of total daily trips. Recent data on modal share for metropolitan Athens are not available as the last travel behavior survey for the entire metropolitan area took place in 2007. Based on that survey, public transport share in metropolitan Athens accounted for 37% of the total trips. In Thessaloniki, according to the Sustainable Mobility Plan of Thessaloniki (https://www.svakthess.imet.gr), in 2019, 59% of the total daily trips within the metropolitan area were made by motorized vehicles (44% by car, 4% by taxi, and 11% by motorcycle) and 41% by sustainable transport modes (27% by bus, 11% on foot, and 3% by bicycle). The share of public transport in Thessaloniki is lower than the one in Athens mainly due to the operation of fixed route modes of transport (e.g., metro, tram, and suburban railway) and the higher public transport density in Athens. The share of active travel in both cities is low, with walking and cycling shares being lower than 10% in Athens whereas in Thessaloniki walking and cycling represent 14% of the total trips due to its smaller size and more compact urban form (Bakogiannis & Siti, 2014; Barmpas et al., 2017; Aifantopoulou, G. et al, 2019 in Papagiannakis & Yiannakou, 2022).

In Athens, a large amount of recent pertinent literature focuses on the effects of the 2010s economic crisis on the travel behavior and satisfaction of Athenians. By 2012 the number of private car trips declined by 30%, trips by taxi declined by 30–40%, while trips by public transport and metro declined only by 9.5% and 8% respectively (Bakogiannis & Siti, 2014). Trips previously made by car were replaced by bicycle trips and walking trips, especially in the 5–15 min range (Bakogiannis & Siti, 2014). The reduction in public transport use was found to be a result of the overall mobility reduction due to the economic crisis, while the demand for public transport from public transport users increased (Efthymiou & Antoniou, 2017). Motives for the use of public transport were higher quality of service, environmental consciousness, and the cost of car usage and maintenance, while disincentives to use public transport were opportunities for car use, cycling, or walking and an increased fare cost (Efthymiou & Antoniou, 2017). Service quality has been found to be the most important determinant of satisfaction for bus users (Efthymiou et al., 2014). More recent studies found that some factors concerning public transport satisfaction, such as on-time performance and network coverage were important throughout the years, while others such as vehicle cleanliness and environmental friendliness were deemed more important before the economic crisis than afterwards (Efthymiou et al., 2018). The COVID-19 pandemic and pilot interventions in the city center, aiming to promote walking and cycling, showed early reports of decreased public transport usage, yet increased walking and cycling especially in the city center (Baig et al., 2022; Papadimitriou, 2020). However, the recent post-pandemic image of the city's transport network is one of excessive traffic congestion, even increased compared to pre-pandemic levels (Lalios, 2021).

In Thessaloniki, the bus system is offering low level of coverage and service and does not meet user expectations and needs (Georgiadis, 2012). In this respect, studies related to travel behavior and travel satisfaction report similar outcomes. Some studies focusing on the infrastructure capacity to meet the needs and expectations of pedestrians and cyclists conclude that there is only a small progress on improving walking and cycling networks in the city, while new modes of transport, like micromobility services did not manage to successfully continue their operation due to financial, legal, and organizational issues (Campisi et al., 2022; Lazou et al., 2015; Papagiannakis et al., 2021, Nikiforiadis et al., 2021; Politis et al., 2020). The COVID-19 pandemic had also a major impact on travel behavior and mobility for Thessaloniki with the number of daily average trips being decreased by 50% (Politis et al., 2021a; Politis et al., 2021b).

On the whole, there are several studies on travel behavior, travel needs and expectations of travelers, as well as capacity and performance evaluation of infrastructure and systems for the cities of Athens and Thessaloniki, yet no studies were found to examine the major issue that this paper addresses: how the use of sustainable transport modes relates to travel satisfaction and travel affect in these two car-dependent compact cities.

3. Data and methods

3.1. Data sources

Data come from an online survey, geographic information systems (GIS), and qualitative interviews. The survey was conducted in Greece in 2020 (for details see Mouratidis & Papagiannakis, 2021). Here we only use data of the metropolitan areas of Athens (489 respondents) and Thessaloniki (523 respondents). Survey participants were asked to fill out their residential address. Next, based on this input, GIS analysis was performed to obtain spatial characteristics of each residential location. Fig. 1 displays maps showing approximate residential locations of the participants in the survey. Residential locations are well distributed within the two metropolitan areas, covering inner city areas as well as inner and outer suburbs and urban forms that range from low to high density. The quantitative analysis focuses on travel to the place of work or education due to data availability (the dataset does not include data on mode choice for other purposes), so we excluded survey participants who did not work or study. The total sample used in the quantitative analysis was therefore reduced to 766 respondents (workforce participants or tertiary-education students), out of which 375 were residents of Athens and 391 were residents of Thessaloniki.

The survey was administered electronically through a social media campaign supplemented with snowball sampling. The social media campaign included posts on Facebook groups, advertising the survey in a popular online magazine dealing with city matters, and inviting people to participate through the research project's webpage. The link to the online survey was posted on numerous Facebook groups (more than 200 groups) including residents' groups of neighborhoods of Athens and Thessaloniki and groups focusing on diverse topics such as local news, sports, politics, history, culture, travel, parenthood, childcare, and people with disabilities. The survey was posted on residents' groups covering most areas of Athens and Thessaloniki to ensure a broad geographical distribution, representation of different urban forms, and participation of diverse socioeconomic groups. Moreover, the survey was distributed to several thematic groups (local news, sports etc.) to obtain responses from residents who are not members of residents' groups. An invitation to participate in the survey was also distributed with an article in an online magazine with large readership (Parallaxi Magazine) to attract participants who are not active on Facebook. Finally, the social media campaign included an invitation to the survey on the project's webpage (https://www.facebook.com/cities.greece). In addition to the social media campaign, snowball sampling was performed by sharing the invitation to the survey to social networks via email or Facebook and asking to further share it with their own social networks. Approximately 65% of the sample was recruited through the social media campaign while 35% was recruited through snowball sampling (different links were distributed for each method). The invitation to participate and the survey questions were written in the Greek language. The survey was pilot tested and revised before its final distribution. No monetary or other incentives were offered to potential survey participants. The sample suffers from biases common for this type of surveys such as under-representation of older adults and citizens with foreign background and over-representation of highly educated citizens (for a detailed comparison of the sample's characteristics with those of the population, see Mouratidis & Papagiannakis, 2021).

The survey included a general open-ended question asking about issues related to the city, the neighborhood, quality of life, and daily travel. Answers pertaining to urban mobility, transport systems, and travel experience were selected for the purposes of this study, followed by qualitative analysis. These qualitative data relate to the initial sample (489 Athens residents and 523 Thessaloniki residents) without excluding residents who did not work or study. In total, N = 126 respondents provided an answer to the open-ended question.

The survey additionally included a question inviting participants to express their interest in participating in a subsequent personal interview. Interested participants provided their email addresses, which were later used to send invitations for interviews. In total N = 14 interviews were carried out, 8 with residents of Thessaloniki and 4 with residents of Athens. Since the participants had been asked to express interest in participating in an interview, self-selection bias might be relevant. The purpose of the qualitative interviews was explanatory, providing insights into the local context and assisting the interpretation of trends identified in the statistical analyses. For that purpose, a larger number of interviews was not deemed necessary. The interviews were carried out electronically. Two options were given to interview participants: interview via email (13 participants chose this option) or via video call (1 participant chose this option). The interviews via email were basically a survey with open-ended questions, while the interview via video call was based on the same questions but was semi-structured. The interviews were carried out during October 2020 - January 2021.

3.2. Variable descriptions

Table 1 explains how the variables used in the study were measured, while Table 2 displays descriptive statistics. Variables on commute well-

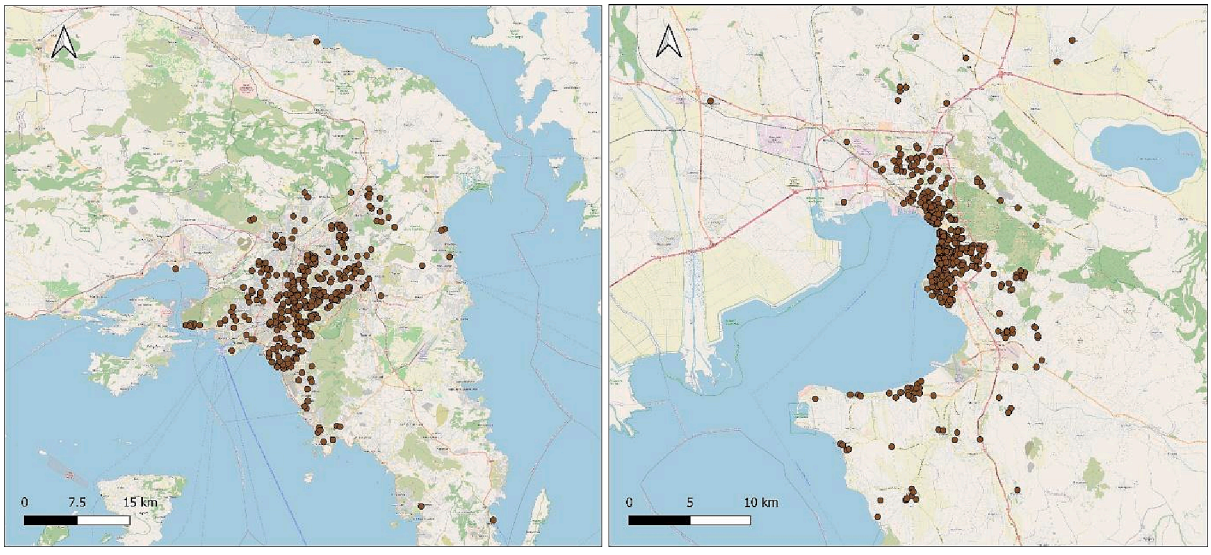

Fig. 1. Maps of the metropolitan areas of Athens (left) and Thessaloniki (right) showing approximate residential locations of survey participants.

Table 1
Measurement.

Variables	Question	Scale	
Commute well-being			
Travel satisfaction	How satisfied are you with your travel to your main occupation?	"Extremely dissatisfied" (0)	"Extremely satisfied" (10)
Travel affect	How would you describe your feelings experienced during a typical trip to your main occupation?	"Very negative" (1)	"Very positive" (5)
Commute characteristics			
Transport mode	What is the main transport mode you typically use to travel to your main occupation?	List of transport modes	
Travel time	How much time do you typically spend to arrive at your main occupation (door to door / one way)?	Travel time in mins	
Commute frequency	How many days per week do you travel to your workplace (or place of study)?	0 days per week	7 days per week
Travel attitudes			
Favorite transport mode	What is your favorite mode of daily travel? Consider the mode you would prefer to use for your daily travel under ideal conditions.	List of transport modes	
Built environment			
Distance to city center	Distance from each participant's dwelling to the city center of Athens or Thessaloniki along the pedestrian network	km	
Neighborhood density	Population density within a 1000 m buffer from each participant's dwelling	persons/hectare within 1 km radius	
Personal characteristics			
Age	Year of birth:	(year)	
Gender	Gender:	Female; Male; Other	
Education level	What kind of education do you have?	Elementary school	Master's or doctoral degree
Cohabitation status	Do you live with a spouse/ partner?	No	Yes
Children in household	How many children live regularly within your household?	0	4 or more
Income	What is your personal monthly net income (approximately)? Please consider the income from all possible sources and subtract possible additional taxes, insurance, and pension.	No income	Higher than 4000 Euro
Disability (or longstanding health issue)	Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?	Yes a lot; Yes to some extent; No	
Overall health	How would you describe your health in general…?	"Extremely poor" (0)	"Extremely good" (10)

Notes: Variables on commute well-being, commute characteristics, travel attitudes, and personal characteristics were obtained via the survey. Variables on the built environment were obtained as follows. Participants filled in their residential address in the survey. Then built environment characteristics around the residential location of each participant were measured with analysis in GIS. Distance to city center was calculated in GIS with network analysis using the Openroute Service. Neighborhood density was measured in GIS based on population density data from FCL and CIESIN (2020).

being, commute characteristics, travel attitudes, and personal characteristics were obtained via the survey. Travel attitudes and certain personal characteristics were categorical variables. These were recoded as binary variables as shown in Table 2. The statistical analyses below also include two basic built environment characteristics as covariates: distance to city center and neighborhood density. These variables aim to capture the residential location and the type of urban form. They were obtained through geospatial analysis in GIS. The residential addresses provided by participants in the survey were first georeferenced. Some participants provided only their postal code and not their full address. In this case, the centroid of the postal zone was considered as an approximation of the residential location. Next, each of these residential locations were individually analyzed to obtain the variables distance to city center and neighborhood density at the level of the individual, as explained in Table 1.

It should be noted that the survey was conducted in April-May 2020, which coincided with the early stage of the COVID-19 pandemic, but the aim was to capture travel behavior and travel satisfaction under normal circumstances. For this, an instruction was given in the survey at the beginning of the page that included the travel behavior and travel satisfaction questions used in this study. The instruction was: "For the following questions, please consider your life right before the coronavirus pandemic (COVID-19)." To further ensure that respondents would assess the pre-COVID-19 period, each of the questions on travel behavior and travel satisfaction included a parenthesis stating "(before COVID-19)". The variable used on overall health was also assessed for before COVID-19 to avoid capturing any possible health implications of the pandemic.

3.3. Analytical approach

This study is based on a mixed methods research approach. Specifically, it applies an explanatory sequential design where patterns found in the quantitative analysis are further elaborated and explained by a subsequent qualitative analysis (Creswell & Clark, 2017). Such approaches can provide meaningful empirical evidence in urban and transportation research (Næss, 2018). However, mixed-methods approaches have been almost non-existent in research related to travel satisfaction in cities, with some exceptions such as the study by Mouratidis et al. (2019). This approach is particularly useful for the purposes of a study such as this one, where the local context may be a key driver of the experience of using different transport modes. The quantitative part examines trends in data that show how different transport modes relate to travel satisfaction, while the qualitative part provides a more nuanced understanding of the local context that helps explain and interpret the findings of the quantitative analysis.

The *quantitative analysis* includes the use of descriptive statistics and multiple regressions. Mode choice, travel times by mode, travel satisfaction by mode, and travel affect by mode were analyzed with descriptive statistics. The next step was to develop regression models that explore how transport modes relate to travel satisfaction and travel affect, after controlling for a series of variables that may influence the effect of travel mode on travel satisfaction and travel affect (e.g., De Vos et al., 2022; Ettema et al., 2016; Glasgow et al., 2019; Mouratidis et al., 2019). These are personal characteristics, commute characteristics (i.e., travel time and commute frequency), built environment characteristics (distance to city center and neighborhood density), and travel attitudes. The statistical approach used for this step was multiple regression. Travel satisfaction and travel affect were measured on 0–10 and 1–5 scales respectively. These are ordinal variables but can be treated as continuous using linear regression (Ferrer-i-Carbonell & Frijters, 2004). For this reason, linear approaches are widely used in travel satisfaction studies (e.g., Cao & Ettema, 2014; De Vos et al., 2022; Humagain &

Table 2
Descriptive statistics.

Variables	Athens (N = 375)				Thessaloniki (N = 391)			
	N	Min/Max	Mean	s.d.	N	Min/Max	Mean	s.d.
Commute well-being								
Travel satisfaction	371	0/10	6.77	2.60	388	0/10	6.13	3.11
Travel affect (emotions during commuting)	373	1/5	3.20	0.95	389	1/5	3.13	1.07
Commute characteristics								
Travel time (mins)[a]	351	1/100	31.28	19.54	374	2/120	28.33	21.35
Commute frequency (days per week)	373	0/7	4.92	1.01	391	0/7	4.91	0.88
Travel attitudes								
Commute by favorite transport mode	375	0/1	0.46	0.50	391	0/1	0.35	0.48
Built environment								
Distance to city center[b] (km)	372	1/57	9.31	6.96	382	0.2/36	8.62	8.66
Neighborhood density[c] (persons/hectare within 1 km radius)	372	1/247	111.28	62.83	382	2/207	98.41	62.17
Personal characteristics								
Age (years)	375	19/72	41.59	11.56	391	18/70	38.38	11.77
Female	375	0/1	0.48	0.50	391	0/1	0.53	0.50
Tertiary education	375	0/1	0.77	0.42	391	0/1	0.70	0.46
Living with partner/spouse	375	0/1	0.62	0.49	391	0/1	0.60	0.49
Household with children	375	0/1	0.44	0.50	391	0/1	0.41	0.49
Income (personal net monthly income in Euros)	375	0/4250	1385.87	974.32	391	0/4250	1047.83	852.18
Disability (or longstanding health issue)	375	0/1	0.14	0.35	391	0/1	0.11	0.32
Overall health (self-reported)	375	0/10	8.04	1.48	391	0/10	8.07	1.45

Notes: Survey questions on travel behavior, commute well-being, and residential location were optional, therefore the number of observations may vary for different variables due to missing data. Survey questions on personal characteristics were mandatory, thus the number of observations is the same for relevant variables.
[a] Median travel time is 30 mins in Athens and 20 mins in Thessaloniki.
[b] Median distance to city center is 8.30 km in Athens and 5.88 km in Thessaloniki.
[c] Median neighborhood density is 103 persons/hectare in Athens and 113 persons/hectare in Thessaloniki.

Singleton, 2020; Mouratidis, 2020; Olsson et al., 2013). The equation used in the regression models is:

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_nx_n.$$

b_i (i = 1,2…n) are the regression coefficients, while y is the dependent variable (Travel satisfaction or Travel affect).

Model 1 includes transport modes and personal characteristics. Transport modes are coded as binary variables where 1 = using this as main transport mode for commuting and 0 = other. "Walking" is used as a reference category, so the coefficients of transport modes are interpreted in relation to walking. Regarding personal characteristics, "Age", "Female", "Tertiary education", "Living with partner/spouse", "Household with children", and "Disability" are also coded as binary variables. "Income" and "Health" are continuous variables measured as shown in Table 1. Model 1 (transport mode + personal characteristics):

$$y = b_0 + b_1\,(Car) + b_2\,(Public\ transport) + b_3\,(Motorcycle) + b_4\,(Bicycle) + b_5\,(Age) + b_6\,(Female) + b_7\,(Tertiary\ education) + b_8\,(Living\ with\ partner/spouse) + b_9\,(Household\ with\ children) + b_{10}\,(Income) + b_{11}\,(Disability) + b_{12}\,(Overall\ health).$$

Model 2 additionally includes built environment characteristics as covariates. These are the continuous variables "Distance to city center" and "Neighborhood density", which are measured as shown in Table 1. Model 2 (transport mode + built environment + personal characteristics):

$$y = b_0 + b_1\,(Car) + b_2\,(Public\ transport) + b_3\,(Motorcycle) + b_4\,(Bicycle) + b_5\,(Travel\ time) + b_6\,(Commute\ frequency) + b_7\,(Distance\ to\ city\ center) + b_8\,(Neighborhood\ density) + b_9\,(Age) + b_{10}\,(Female) + b_{11}\,(Tertiary\ education) + b_{12}\,(Living\ with\ partner/spouse) + b_{13}\,(Household\ with\ children) + b_{14}\,(Income) + b_{15}\,(Disability) + b_{16}\,(Overall\ health).$$

Model 3 is the full model of the analysis that additionally includes travel attitudes as a covariate. This is a binary variable coded as 1 = uses favorite transport mode for commuting and 0 = other. Model 3 (transport mode + travel attitudes + built environment + personal characteristics):

$$y = b_0 + b_1\,(Car) + b_2\,(Public\ transport) + b_3\,(Motorcycle) + b_4\,(Bicycle) + b_5\,(Travel\ time) + b_6\,(Commute\ frequency) + b_7\,(Commute\ by\ favorite\ transport\ mode) + b_8\,(Distance\ to\ city\ center) + b_9\,(Neighborhood\ density) + b_{10}\,(Age) + b_{11}\,(Female) + b_{12}\,(Tertiary\ education) + b_{13}\,(Living\ with\ partner/spouse) + b_{14}\,(Household\ with\ children) + b_{15}\,(Income) + b_{16}\,(Disability) + b_{17}\,(Overall\ health).$$

The *qualitative analysis* is based on residents' insights into urban mobility in Athens and Thessaloniki. Qualitative data were collected through the questionnaire survey (N = 126 respondents to open-ended question in the survey) and personal qualitative interviews with residents (N = 14 interviews). The questionnaire survey included an open-ended question on issues related to the city, the neighborhood, quality of life, and daily travel. The personal interviews extracted more nuanced knowledge on the same topics. The data were analyzed with the Thematic Analysis method. For the purposes of the paper, qualitative material related to urban mobility was selected and was analyzed using the six steps of Thematic Analysis by Braun and Clarke (2006). The main themes were selected to inform about travel experience by different transport modes in the two cities under study. Four different transport modes were mainly discussed by survey and interview participants: public transport, walking, cycling, and car. Besides themes on these four transport modes, we chose an additional theme that synthesizes residents' recommendations for improvement regarding sustainable mobility and travel satisfaction.

4. Results

4.1. Quantitative analysis

Fig. 2 shows the sample's mode choice for commute trips in Athens and Thessaloniki. Results confirm that both cities are largely car-dependent. According to the results, 58% of Athens residents and 59% of Thessaloniki residents use a car to arrive at their main occupation. Although car mode share is often higher in certain regions (e.g., North America), compared to other compact cities (often present in Europe and Asia), the use of private car can be considered to be high. Public transport accounts for 19% and 17% for Athens and Thessaloniki respectively. 12% of Athens residents and 17% of Thessaloniki residents

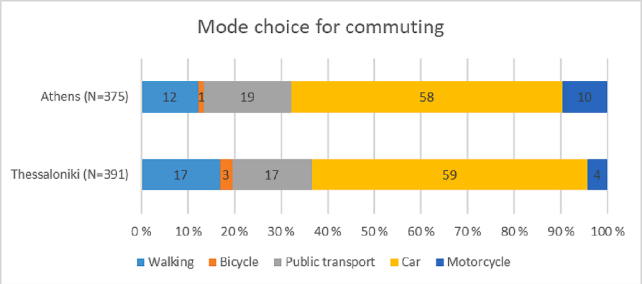

Fig. 2. Mode choice for commute trips in Athens and Thessaloniki. *Note*: Mode refers to the main mode of transport typically used to arrive at the main occupation.

walk to their main occupation. The use of bicycle for commuting is rather limited in both cities, 1% in Athens and 3% in Thessaloniki. The relatively higher walking and cycling shares in Thessaloniki are possibly due to the city's smaller size and shorter distances (see e.g., Table 1, note b). The use of motorcycle is considerable compared to other European cities, 10% in Athens and 4% in Thessaloniki. Private motorized transport modes (car and motorcycle) for commuting account for 68% in Athens and 63% in Thessaloniki, while sustainable transport modes (walking, bicycle, and public transport) for commuting account for 32% in Athens and 37% in Thessaloniki. The relatively higher share of active transport modes (walking and bicycle) in Thessaloniki than Athens is in accordance with the modal share estimated in the Sustainable Mobility Plan of Thessaloniki according to which 14% of the trips were made on foot and bicycle whereas in Athens this share was lower than 10% in the last travel behavior survey (see Section 2.2 above). The higher shares of motorized modes and reversely the lower shares of public transport in our survey compared to previous modal split data from both cities are possibly due to our survey concerning commute trips and not total trips.

Fig. 3 shows the mean travel time for commute trips by transport mode in Athens and Thessaloniki. Travel times are substantially longer for commute trips by public transport compared to all other modes (including car). Reasons for this may include: first-last mile travel for accessing public transport stops, waiting for public transport, slow vehicles speeds for buses due to traffic, traffic or parked vehicles obstructing bus lanes, multi-modal trips, multi-stage trips, and long trips to or from the outskirts of cities. Active travel (walking and bicycle) times are relatively short, which is likely due to the lower threshold of

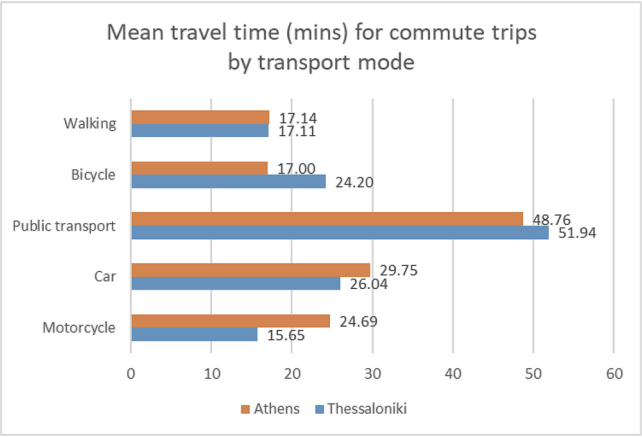

Fig. 3. Mean travel time (in minutes) for commute trips by transport mode in Athens and Thessaloniki. *Notes*: Median travel times in Athens are 15 mins for walking, 17.5 mins for bicycle users, 46.5 mins for public transport users, 30 mins for car users and 20 mins for motorcycle users. Median travel times in Thessaloniki are 15 mins for walking, 20 mins for bicycle users, 45 mins for public transport users, 20 mins for car users and 15 mins for motorcycle users.

acceptable travel time by these modes. Car and motorcycle yield much shorter travel times than public transport highlighting the comparative advantage that these modes have in a context where restrictions against private motorized travel are lacking, and public transport provisions are insufficient.

Fig. 4 and Fig. 5 display mean travel satisfaction and travel affect by transport mode in Athens and Thessaloniki. Walking is the mode that results in the highest travel satisfaction and travel affect in both cities. Conversely, users of public transport, on average, report the lowest travel satisfaction and travel affect in both cities. However, there is a substantial difference in means between the two cities. Mean travel satisfaction of public transport users is 5.80 in Athens and 3.00 in Thessaloniki, while mean travel affect is 2.93 in Athens and 2.00 in Thessaloniki.

Next, we explore how transport modes relate to travel satisfaction and travel affect using multiple linear regression analysis. Table 3 and Table 4 report the results for Athens and Thessaloniki respectively. Six statistical models are developed for each city. Travel satisfaction is the dependent variable for the first three models and travel affect is the dependent variable for the next three models. The three models for each dependent variable are developed as follows. The first model includes only transport modes and personal characteristics. The second model additionally includes commute characteristics (travel time and commute frequency) and built environment variables (distance to city center and neighborhood density). The third model additionally includes travel attitudes (whether or not the favorite transport mode was used during the commute trip).

Results in Table 3 indicate that, for the case of Athens, walking and cycling are more positively related to travel satisfaction and travel affect compared to car, public transport, and motorcycle when travel time is not controlled for (model 1). When travel time is included in the models (models 2 and 3), walking, cycling, and public transport use are associated with higher travel satisfaction and travel affect than the car and motorcycle. We observe that when we adjust for travel time, the statistical effect of public transport use on travel satisfaction and travel affect becomes similar to the effect of walking and cycling. These results suggest that the long travel times associated with public transport use are largely responsible for the lower travel satisfaction and travel affect when using this mode. The car and the motorcycle are the modes associated with the lowest travel satisfaction and travel affect when controlling for travel time. On the contrary, walking and bicycle are the modes associated with the highest travel satisfaction and travel affect both when controlling for travel time and when not.

Findings in Table 4 show that, for the case of Thessaloniki, walking and motorcycle are more positively related to travel satisfaction compared to bicycle, car, and public transport when travel time is not controlled for (travel satisfaction model 1). Walking, bicycle, and motorcycle are more positively related to travel affect compared to car and public transport when travel time is not controlled for (travel affect model 1). When travel time is included in models 2, travel satisfaction and travel affect are higher for walking, bicycle, and motorcycle than for car and public transport. Results are similar for travel affect when travel attitudes are included (travel affect model 3). Travel satisfaction is higher for walking and motorcycle than for bicycle, car, and public transport when travel attitudes are included (travel satisfaction model 3). We observe that when we adjust for travel time, the statistical effect of public transport use on travel satisfaction and travel affect becomes weaker, but, even then, both travel satisfaction and travel affect remain considerably lower for public transport than for walking, motorcycle, and bicycle. Nevertheless, this improvement suggests that the long travel times associated with public transport use in Thessaloniki play an important role in the very low travel satisfaction and travel affect when using this mode of transport.

Both Table 3 and Table 4 indicate that travel time is an important predictor of travel satisfaction and travel affect. Results show that the longer the travel time is, the lower the travel satisfaction and travel

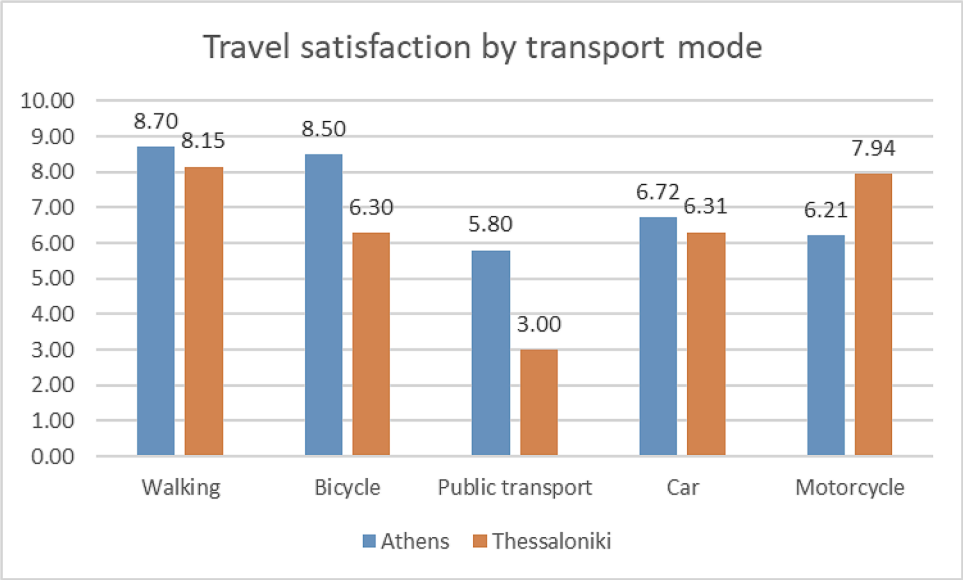

Fig. 4. Mean travel satisfaction for commute trips by transport mode in Athens and Thessaloniki. *Notes*: Median travel satisfaction in Athens is 9.00 for walking, 9.00 for bicycle users, 6.00 for public transport users, 7.00 for car users, and 7.00 for motorcycle users. Median travel satisfaction in Thessaloniki is 9.00 for walking, 6.50 for bicycle users, 2.00 for public transport users, 7.00 for car users, and 8.00 for motorcycle users.

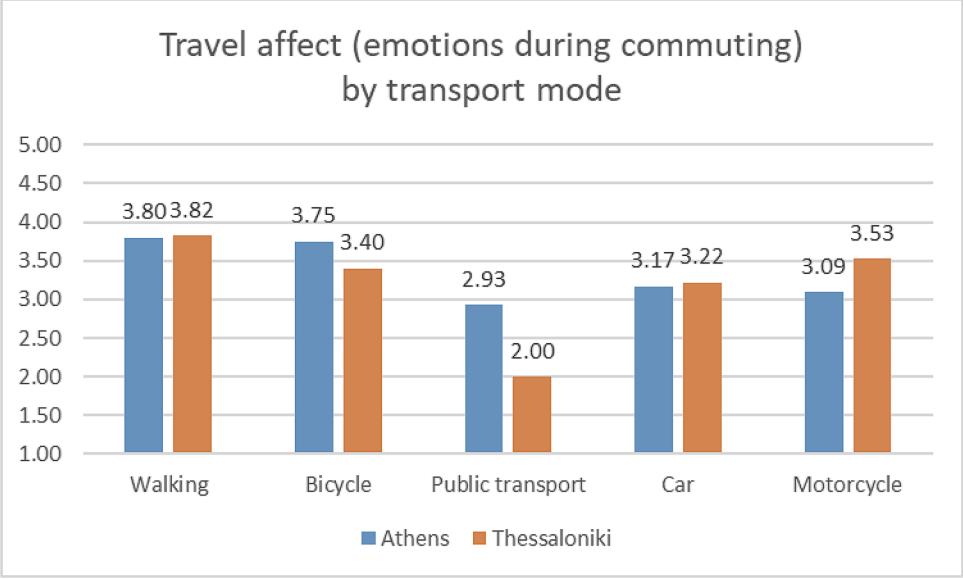

Fig. 5. Mean travel affect for commute trips by transport mode in Athens and Thessaloniki. *Notes*: Median travel affect in Athens is 4.00 for walking, 4.00 for bicycle users, 3.00 for public transport users, 3.00 for car users, and 3.00 for motorcycle users. Median travel affect in Thessaloniki is 4.00 for walking, 3.50 for bicycle users, 2.00 for public transport users, 3.00 for car users, and 3.00 for motorcycle users.

affect will be. Moreover, models 3 in Table 3 and Table 4 show that commuting by one's favorite transport mode is associated with higher travel satisfaction and travel affect. Associations between the built environment and travel satisfaction/affect are also presented. The built environment influences travel behavior (travel time and mode) and in turn travel satisfaction/affect so to examine how the built environment relates to travel satisfaction/affect, this indirect effect needs to be considered either with structural equation modeling or stepwise regression models (Mouratidis et al. 2019). However, this has not been done here as this relationship is not the focus of the present paper. What is found in the present analysis is that distance to city center and neighborhood density are not significantly associated with travel satisfaction when travel time and transport modes are included in the models. Distance to city center is associated with higher travel affect in Athens, suggesting that those who live further away from the city center experience more positive emotions during their commute trips, when we account for neighborhood density, transport mode used, travel time, commute frequency, and travel attitudes (travel affect models 2 and 3 in Table 3). Moreover, neighborhood density is associated with lower travel affect in Thessaloniki, suggesting that those who live in denser neighborhoods experience more negative emotions during their commute trips, when we account for dwelling's distance to city center, transport mode used, travel time, commute frequency, and travel attitudes (travel affect models 2 and 3 in Table 4).

Table 3
Linear regression models of travel satisfaction and travel affect in Athens.

Variables	Commute well-being in Athens					
	Travel satisfaction			Travel affect		
	1	2	3	1	2	3
Transport mode (ref = walking)						
Car	−0.412***	−0.231***	−0.240***	−0.351***	−0.170*	−0.176*
Public transport	−0.449***	−0.067	−0.055	−0.357***	−0.029	−0.016
Motorcycle	−0.303***	−0.217***	−0.236***	−0.224***	−0.151*	−0.167**
Bicycle	−0.005	−0.010	−0.024	−0.007	−0.004	−0.018
Commute characteristics						
Travel time		−0.594***	−0.573***		−0.498***	−0.478***
Commute frequency		0.036	0.037		0.059	0.061
Travel attitudes						
Commute by favorite transport mode			0.117*			0.116*
Built environment						
Distance to city center		0.062	0.050		0.170*	0.159*
Neighborhood density		−0.014	−0.015		0.033	0.033
Personal characteristics						
Age (years)	0.060	0.016	0.028	0.127*	0.118*	0.132*
Female	−0.069	−0.008	−0.009	0.007	0.052	0.052
Tertiary education	−0.012	0.022	0.028	−0.019	0.005	0.010
Living with partner/spouse	−0.078	−0.106*	−0.102*	−0.067	−0.097	−0.094
Household with children	0.057	0.075	0.071	0.024	0.036	0.033
Income	0.053	0.054	0.043	0.068	0.045	0.032
Disability	0.023	0.018	0.008	−0.012	−0.037	−0.046
Overall health	0.183***	0.129**	0.130**	0.073	0.034	0.035
Summary statistics						
N	371	343	343	373	345	345
Adjusted R-squared	0.121	0.384	0.394	0.066	0.276	0.286

Notes: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Coefficients shown are standardized beta coefficients. Sample sizes are slightly different across models due to missing data.

Table 4
Linear regression models of travel satisfaction and travel affect in Thessaloniki.

Variables	Commute well-being in Thessaloniki					
	Travel satisfaction			Travel affect		
	1	2	3	1	2	3
Transport mode (ref = walking)						
Car	−0.302***	−0.242***	−0.221***	−0.287***	−0.302***	−0.288***
Public transport	−0.570***	−0.298***	−0.241***	−0.592***	−0.364***	−0.324***
Motorcycle	−0.008	−0.004	−0.036	−0.037	−0.031	−0.052
Bicycle	−0.098*	−0.077	−0.097*	−0.056	−0.043	−0.056
Commute characteristics						
Travel time		−0.464***	−0.476***		−0.390***	−0.399***
Commute frequency		−0.025	−0.036		0.002	−0.004
Travel attitudes						
Commute by favorite transport mode			0.191***			0.132**
Built environment						
Distance to city center		−0.006	0.013		0.057	0.071
Neighborhood density		−0.110	−0.079		−0.177**	−0.153*
Personal characteristics						
Age (years)	−0.023	−0.019	−0.031	0.090	0.098	0.089
Female	0.031	0.046	0.049	0.062	0.065	0.069
Tertiary education	−0.023	0.004	−0.007	−0.054	−0.023	−0.031
Living with partner/spouse	0.05	0.034	0.061	−0.018	−0.051	−0.033
Household with children	0.011	−0.013	−0.019	0.039	0.016	0.013
Income	0.142	0.128*	0.125	0.113*	0.112*	0.112*
Disability	−0.064	−0.057	−0.072	−0.070	−0.064	−0.076
Overall health	0.073	0.078	0.057	0.030	0.034	0.020
Summary statistics						
N	388	362	362	389	363	363
Adjusted R-squared	0.273	0.425	0.456	0.288	0.423	0.437

Notes: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Coefficients shown are standardized beta coefficients. Sample sizes are slightly different across models due to missing data.

4.2. Qualitative analysis

4.2.1. Public transport

The qualitative analysis highlights issues with public transport provisions in both cities under study. Several residents of Athens metropolitan area explain that public transport is often inadequate. Key issues reported are the infrequent departures, inconsistent departures, poor connection between areas, need for multistage trips, safety issues, old vehicles, and poor access to public transport stops from certain residential locations:

> "I am only dissatisfied with public transport [old buses, a few inconsistent routes]" (Female, 30 years, Athens)

"…public transport use needs to be extended to serve citizens faster and safer." (Male, 44 years, Athens)
"Although I have my own vehicle and love traveling and using a motorbike, in the Alimos area for example, there is no good public transport at all if you need it. To get to Athens [*city center*], you change 3 modes of transport. And to go to a neighboring municipality like Nea Smyrni, there is NO CONNECTION!" (Male, 50 years, Athens)
"I would like there to be very frequent local public transport in my municipality [*Municipality of Alimos*]. Saving time with shorter commutes allows me to travel on foot and enjoy a more relaxed style and pace of life." (Female, 54 years, Athens)
"Public transport is a problem. There is not enough offer. OK, now with the metro the situation is getting better but there are still problems. …In our municipality, there is not easy access for those who are not close to the metro station. […] It [*public transport*] needs to run 24 h, to be frequent, because if it stops and you cannot come back [*home*]. Then, I am obliged to use my motor scooter. If I need to wait 1, 1.5, 2 h to get the bus…" (Male, 39 years, Athens)

Qualitative input from residents of Thessaloniki metropolitan area also indicates a problematic situation with regard to public transport. The situation seems to be, nevertheless, even more problematic than in Athens, as Thessaloniki residents' comments are harsher. Public transport provision in Thessaloniki is even labeled by some residents as "non-existent", "a mess", or "completely unacceptable". This difference in the qualitative input between the two cities is in line with the considerable difference in travel satisfaction for public transport users found in the quantitative results of the present study. Some illustrative quotes regarding public transport in Thessaloniki are shown here:

"You can make a thousand surveys, but you will not find a solution to the mess called OASTH [*public transport organization of Thessaloniki*]." (Female, 53 years, Thessaloniki)
"… public transport was and is non-existent…Thessaloniki could have a tram and a trolleybus." (Male, 31 years, Thessaloniki)
"…Thessaloniki suffers from public transport." (Male, 19 years, Thessaloniki)
"Public transport is a huge problem." (Female, 26 years, Thessaloniki)
"…public transport is completely unacceptable." (Male, 36 years, Thessaloniki)
"Almost non-existent public transport." (Male, 51 years, Thessaloniki)
"Public transport is not enough." (Female, 58 years, Thessaloniki)

4.2.2. Walking

Although travel satisfaction for those who walk was found to be high in the quantitative results, qualitative insights suggest that walking infrastructure is, on some occasions at least, problematic and needs considerable improvements. It should be noted that walking infrastructure may differ considerably across areas. For example, in Thessaloniki city center sidewalks and pedestrian areas were refurbished not so long ago. However, residents still point out maintenance issues:

"Poor maintenance of sidewalks." (Male, 51 years, Thessaloniki)
"…the sidewalks are dangerous for older people because many tiles are broken." (Female, 69 years, Thessaloniki)

In the more central areas of Athens walking infrastructure is older and sidewalks may be too narrow, with many obstacles, and generally in poor condition:

"The small sidewalks with dozens of obstacles (parking lot entrances, signs, pillars, trees, broken slabs, anti-parking bollards and so much more) make it difficult to cross safely and generally live in the city." (Male, 44 years, Athens)
"[*There is a need for*] …sidewalks suitable for pedestrians, children, and wheelchairs." (Female, 50 years, Athens)
"I would like my neighborhood to have unobstructed sidewalks and an unobstructed bike lane network." (Female, 43 years, Athens)
"As odd as it sounds, I suggest that the sidewalks are clear with no trees, light posts, planting beds, etc. all with provision for a stroller." (Male, 44 years Athens)

In suburban areas, sidewalks are, at times, in poor condition and even non-existent in certain cases:

"There are no sidewalks. The city is hostile to children." (Male, 50 years, Athens)
"The infrastructure on the roads and sidewalks is very poor, almost non-existent. While it is considered an expensive area [*the area I live in*], there are no sidewalks for walking." (Male, 39 years, Athens)

4.2.3. Cycling

Both Athens and Thessaloniki lack cycling infrastructure. No proper network of bike paths and bike lanes can be found and other types of cycling infrastructure such as bicycle parking, bicycle signs, and bicycle signal lights are missing. The few existing bike lanes are disconnected and often unsafe due to car traffic. The lack of cycling infrastructure largely explains the very small modal share of cycling shown in Fig. 2. Residents' comments highlight the need for bicycle infrastructure:

"Unacceptable bicycle lanes…" (Male, 51 years, Thessaloniki)
"I want bike lanes for downtown and low-lying suburbs." (Male, 70 years, Thessaloniki)
"Designate a network of cycle paths for all areas of the city separate from the car network." (Female, 60 years, Thessaloniki)
"It would be good to have cycle paths with the right specifications." (Male, 36 years, Thessaloniki)
"…network of cycle paths and not disconnected cycle paths. […] The lack of resident-friendly routes for both walking and cycling and the high traffic in the area." (Male, 44 years Athens)

4.2.4. Cars

The qualitative analysis illustrated the situation of car-dependency in both cities examined in this study. The large number of moving and parked cars was even more pronounced by residents of Thessaloniki. Certain residents also stress that reducing cars and car traffic is important for improving quality of life in cities.

"The city has a serious problem with cars. [..] You see cars everywhere. Tragic…on sidewalks, in parks, etc. […] What I noticed during the pandemic and especially the lockdown is that the city without cars is fantastic!!!" (Male, 19 years, Thessaloniki)
"I think everyone's life would be better in the cities if we dramatically reduced the number of cars/parked cars." (Female, 39 years, Thessaloniki)
"Reducing car traffic is a very important factor for improving quality of life in the city." (Female, 41 years, Athens)
"I believe that quality of life would be raised to a high level, with much less noise from cars and motorbikes…" (Female, 50 years, Athens)

4.2.5. Residents' recommendations for sustainable mobility and travel satisfaction

Several residents offered suggestions on how to increase the modal share of sustainable transport modes (active travel and public transport), reduce car-dependency, but also improve the experience of travel within cities. According to several residents, the key to reducing car dependency would be to substantially improve public transport provision. Several participants mention that an improved, frequent public transport system would make them use their car less frequently and that

an improved public transport would be important for their life overall.

> "Car dependency is a function of the public transport available in each city. Yes, I can leave the car, but with half public transport, I can't…" (Male, 35 years, Thessaloniki)
> "Ideally, if public transport was working adequately, I would use my car much less." (Female, 39 years, Thessaloniki)
> "More urban rail transit in cities is the solution to sustainable mobility!" (Male, 30 years, Athens)
> "Personally, I believe that mobility is a key factor in the quality of life in the urban fabric. If the dwelling has good access to public transport, I believe this saves valuable time every day." (Male, 20 years, Athens)
> "…the size and geography of the city […] is such that liberation from cars could be very easily achieved through cycle paths (for bicycle and skate use) and frequent bus routes. The distances covered by the residents of Thessaloniki are usually short and the use of private cars is not really required…" (Male, 42 years, Thessaloniki)

In addition to public transport improvements, developing extended, high-quality cycling infrastructure would encourage certain residents to cycle more and improve cycling experience for the few ones who already cycle. At the same time, residents suggest that pedestrianization projects and improved walking infrastructure are needed to provide safe mobility by foot and encourage residents to walk more. Lastly, one resident argues that reducing cars can be achieved, not only by enhancing the conditions for traveling with other modes, but also by applying car restrictions in cities.

> "[*There is*] relative traffic congestion. Traffic congestion can be reduced in two ways, either by adequate public transport coverage and developed bicycle infrastructure etc. or by restrictive and 'urban planning' measures (bans and pedestrianization)." (Male, 63 years, Athens,)
> "We need more parks, greenery, cycle paths, sidewalks, and better public transport. Discouraging car use can only be achieved if alternatives are provided." (Female, 41 years, Athens)
> "I responded to this survey for one reason only. Because I want to emphasize that it is now necessary to extend the cycle paths and make the existing ones safe. More streets should be pedestrianized as well. How can we stop using our cars when walking is a threat to our lives?" (Female, 44 years, Athens)

5. Discussion and conclusions

5.1. Summary and discussion of findings

This study has investigated how (sustainable) transport modes relate to travel satisfaction and travel affect in two car-dependent compact cities. A mixed-methods approach has been employed comprising statistical analyses of survey and geospatial data and thematic analysis of qualitative data from survey and interviews.

Results suggest that travel satisfaction and travel affect are highest for those who *walk* for commuting independently of personal characteristics, travel time, commute frequency, built environment characteristics, and travel-related attitudes. Although the cities examined in the study are often characterized by insufficient walking infrastructure, high car traffic, and excessive or illegal street parking that altogether make walking less attractive and less safe, walking remains the most satisfying and pleasant mode, in line with studies from different contexts (e.g., De Vos et al., 2016; Ettema et al., 2011; Glasgow et al., 2019; Páez & Whalen, 2010; Singleton, 2019; Ye & Titheridge, 2017).

Conversely, travel satisfaction and travel affect are lowest for those who commute by *public transport* (the essential medium- and long-distance option for sustainable mobility in cities). This is largely due to very long travel times, substantially longer than any other mode in the two cities under study. Interestingly though, when controlling for travel time, travel satisfaction and travel affect are similar for active travelers and public transport users in Athens, and higher than for car and motorcycle users. The high travel satisfaction and travel affect for Athens' public transport users when travel time is accounted for is a unique finding compared to previous studies in other contexts. It could be perhaps partially attributed to the multimodal public transport system in this city which includes metro and suburban railway, modes that users may evaluate quite positively. In Thessaloniki, public transport provision is particularly poor and very negatively perceived by residents, and travel satisfaction and travel affect for public transport riders are substantially lower than in Athens but also very low in relative terms. Therefore, public transport use, together with car use, is associated with lower travel satisfaction and travel affect in Thessaloniki even after accounting for travel time and other factors. These differences in travel experience for public transport riders in Athens and Thessaloniki support the idea that contextual differences, and specifically in terms of transport provisions and policies, play a major role in shaping travel satisfaction and travel affect. These results also highlight the strong predicting role of trip duration in travel satisfaction and travel affect, as also found by previous studies (e.g., De Vos et al. 2022; Lades et al. 2020). The considerably higher travel times for public transport users in Athens and Thessaloniki (Fig. 3) are also a matter of transport provisions and policies and they should be reduced to improve the experience and attractiveness of public transport use.

Residents using the most unsustainable transport mode, the *car*, report substantially lower travel satisfaction and travel affect than those who walk or cycle for commuting. Moreover, car use is associated with lower travel satisfaction and travel affect than public transport use, when adjusting for travel time, in the case of Athens. This finding is in line with studies from certain contexts reporting lower travel satisfaction and travel affect for car users than for public transport users when travel time is accounted for (Legrain et al., 2015; Mokhtarian et al., 2015; Mouratidis et al., 2019). In sum, results indicate that low satisfaction with public transport use is largely explained by long trip durations, while trip duration only has limited effects on satisfaction and affect of car drivers.

An interesting outcome is that the *motorcycle* is found to be, together with active travel modes, among the most satisfying and pleasant transport modes in Thessaloniki. The shorter distances in Thessaloniki along with uncontrolled (and illegal) motorcycle parking, facilitate the use of this mode for commuting. The pleasant experience of motorcycle users in Thessaloniki is in accordance with findings from a study in France by Mokhtarian et al. (2015) who also find that riding a motorcycle is more pleasant than car driving and public transport use. Nevertheless, the sample size of motorcycle users in Thessaloniki is rather limited so this result should be interpreted with caution.

The modal share of *cycling* is very small in the cities of this study to allow us to reach safe conclusions regarding this mode. This is due to the very few cyclists in the cities examined in the study. What we observe is that, despite the lack of cycling infrastructure, the very few residents who cycle for commuting purposes report relatively high levels of travel satisfaction and travel affect. Possibly, the limited bike lanes that exist in the two cities are convenient for these few cyclists enabling them to reach their place of work or education and/or these respondents are bicycle enthusiasts who are not so affected by the unsafe or inappropriate cycling conditions they encounter. Similarly, other studies in countries with limited cycling (e.g., US, Canada) also found high cycling satisfaction (e.g., Singleton, 2019; St-Louis et al., 2014). It is interesting however to note here the relatively lower mean travel satisfaction for bicycle users in Thessaloniki than in Athens. One would expect the reverse results taking into consideration the smaller size of Thessaloniki and its higher compactness. Although the very low sample of bicycle users among the respondents may have considerably affected this result, another tentative explanation could be that Thessaloniki essentially has only one long and safe bike lane, the lane that goes along its quay and attracts many cyclists. The few other bike lanes that were constructed in

the city have been criticized strongly for improper design and lack of safety and some of them were eventually removed.

Results also indicate that travel attitudes have a significant influence on travel satisfaction and affect, both in Athens and Thessaloniki. Those who are able to travel with their preferred travel mode are more satisfied and experience more positive emotions while traveling compared to those forced to travel with an undesired mode. This is in line with studies indicating that the attitude towards the chosen mode strongly impacts travel satisfaction (e.g., De Vos, 2018; Mokhtarian et al., 2015; St-Louis et al., 2014; Ye & Titheridge, 2017).

In this discussion, we have identified and explained differences (as well as similarities) in findings between (i) two car-dependent compact cities internally, and (ii) these two cities and cities representing different contexts in previous studies. Overall, findings from the study indicate that the experience of travel with different transport modes is largely shaped by the local context, including factors such as transport infrastructure, transport policies, urban form, and city size. Particularly context-dependent are found to be the satisfaction and emotions related to the use of public transport, car, and motorcycle. One finding that persists independently of the context is that the most sustainable modes – walking and cycling – are, on average, the most satisfying and pleasant options for urban mobility. At the same time, however, the local context shapes travel behavior, enabling or discouraging the use of different transport modes, which means that it largely affects how many people will use satisfying and pleasant modes for their travel within urban areas.

5.2. Policy implications for sustainable mobility

The findings of this research highlight the fact that sustainable mobility, as urban sustainability in general, is a goal that necessitates integrated planning policies and actions with multidimensional objectives. The two cities analyzed in this study have characteristics of sustainable urban form with potential for shorter trips and high accessibility by walking and/or cycling to amenities and services at a neighborhood, district, but also a wider city scale. Such cities may offer access to amenities and urban vitality but are also faced with the disadvantages of dense and highly compact development (usually lack of open and green space, higher temperatures, environmental degradation, congestion etc.), problems that may lead to further suburbanization. Local politics in both cities was long preoccupied either with emblematic public works, in previous decades, or later in the 2010s dealing with the impacts of economic crisis on local economic development. Thus, despite the multiple sustainable mobility plans that have been prepared during the last years, the actual urban policies in both cities were rarely interested in the restriction of private car use and the shift to sustainable mobility. Such a shift should deploy the advantages of the urban form by integrating public transport to function as the backbone of sustainable mobility.

To shift to sustainable mobility, these cities can use policy instruments that have been shown to discourage car use including congestion charges, car-free streets and neighborhoods, and reduced street parking (Santos et al., 2010). Such measures are probably the most effective in reducing car use (Kuss & Nicholas, 2022) despite not being emphasized by residents in the qualitative analysis. Measures to restrict private car use should be accompanied by massive improvements in public transport with an integrated coordination of different modes (Santos et al., 2010). Also, in the case of Thessaloniki, a critical priority is the completion of its main urban rail transport, the Thessaloniki metro. Furthermore, there is a need to make use of the advantages of these cities' urban form in innovative ways to implement sustainable mobility at a neighborhood and district level along with linking this form of mobility with the higher accessibility to jobs, local markets, and amenities that their urban form offers. The citizens' travel satisfaction and travel affect for walking and cycling, one of the main findings in this research, show that there is much room for connecting the advantages of compact urban form with walking and cycling by transforming part of the road network into a well-connected network of sidewalks, bike paths, and green urban corridors.

5.3. Limitations and future research

As this research has shown, the context plays a crucial role in the experience of traveling with different transport modes within cities. Therefore, analyses of multiple cities in the same study are needed to understand how the diversity in transport provisions and policies, urban form, city size, culture, and attitudes shapes travel satisfaction and travel affect. The mixed-methods approach in this study indicates that combining qualitative and quantitative data in future research is useful for explaining contextual differences and similarities. The survey data analyzed in this study were collected via a social media campaign and snowball sampling. Therefore, the sample's characteristics differ from the general population since highly educated citizens are over-represented and older and immigrant citizens are under-represented in the survey. To counter this issue, we developed regression models that include a range of sociodemographic variables. However, future studies with representative samples could produce more reliable estimates. The analysis presented here did not explore the possible interaction between commute mode and commute duration. Possible interaction effects would be interesting to examine in future research focusing on car-dependent compact cities. Future studies could also be based on larger samples to further distinguish between mobility options in cities, by additionally examining, for example, e-scooters, bikesharing, carsharing, and ridehailing (Mouratidis, 2022a). Finally, this study has attempted to shift the focus towards the link between travel-related well-being and sustainable mobility. It is important that future studies on travel satisfaction or travel affect further examine this link to provide robust recommendations for happy, meaningful, and sustainable urban mobility.

CRediT authorship contribution statement

Kostas Mouratidis: Conceptualization, Methodology, Investigation, Formal analysis, Visualization, Writing – original draft, Writing – review & editing, Funding acquisition, Project administration. **Jonas De Vos:** Writing – original draft, Writing – review & editing. **Athena Yiannakou:** Investigation, Writing – original draft, Writing – review & editing. **Ioannis Politis:** Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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