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Green mobility at home, green mobility at tourism destinations: A cross-country study of transport modal choices of educated young adults

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ABSTRACT

Fostering environmentally friendly transport solutions for visitors lies at the core of the strategies aimed at implementing sustainable tourism destinations. In this sense, this study aims to identify the determinants of green mobility choices taken by young adults during their holidays. It is based on a survey proposed to Italian and Spanish University students. The study demonstrates the intrinsic relationship between the transport mode choices at home and at tourism destinations. The correlation of other variables that could cause bias on mobility choices at tourism destinations is tested (visits undertaken, and transport mode used to reach the destination). The use of bivariate probit models allows to disentangle that male gender, coastal destinations, and car ownership lead to more unsustainable mobility at tourism destination. In contrast, the results indicate that students visiting top international destinations are more likely to present a greener mobility.

1. Introduction

Transport-related tourism activities, both towards and within tourism destinations, cause environmental consequences particularly connected to GHG emissions (Peeters and Dubois, 2010). In fact, the total tourism-related CO_2 emissions accounts for approximately 22% of total transportation emissions (World Tourism Organisation and International Transport Forum, 2019). However, the negative externalities of mobility and transport-related tourism activities are not only restricted to global environmental issues, but also generate social and economic impacts at the local level (Koens et al., 2018) (e.g. congestion or overcrowding, low road safety, conflicts in the uses of public spaces between residents and tourists, etc.). These side effects must be tackled by public authorities to reduce the negative environmental externalities, to enhance the experience of tourists and to increase the quality of life and the socioeconomic benefits of the residents (Anton Clavé, 2019). In this context, one of the main challenges at tourism destinations is the fostering of green mobility habits among the local residents, but most importantly among the seasonal population (i.e. visitors). Thus, the adaptation of tourism destinations to promote green mobility should be at the centre of political action.

The existing literature has tended to focus on the tourists' modal choice towards the destination, in search of new strategies fostering sustainable transportation and technological improvements (e.g., ICT or ZEVs) (Peeters and Dubois, 2010). The contributions on transport mode decisions of tourists at destinations have also grown in the last decade (Gutiérrez and Miravet, 2016; Romão and Bi, 2021). However, only Zamparini and Vergori (2021) and Maltese et al. (2021) have dealt with the identification of the determinants of modal choices both at home and at tourism destinations of the same individuals under analysis, but none of them has empirically analysed the potentially intrinsic relationship between the daily and the tourism-related travel behaviour.

According to previous studies, pro-environmental behaviour may vary according to the context at home or at tourism destinations (Barr and Prillwitz, 2012; Prillwitz and Barr, 2011); specifically, when travelling tourists could be less concerned about the (local) environment than when they are at home (Kiatkawsin and Han, 2017; Miller et al., 2015). Part of the literature (e.g., Suchanek and Szmelter-Jarosz, 2019) has stated that young adults seem more concerned about environment, and tend to adopt an environmentally responsible behaviour. In this context, this study aims to identify the determinants of green mobility choices (public transport and active mobility) taken by educated young adults during their holidays at different tourism destinations. The emphasis on young adults is due to the fact that various studies have

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claimed that young people display a positive attitude towards the environment which also refers to their mobility patterns (see, among others, Le-Klähn et al., 2015; Kiatkawsin and Han, 2017; Suchanek and Szmelter-Jarosz, 2019).

Following the existing literature, the relevance of socioeconomic and travel-related attributes on mobility choices during holidays are investigated. However, the literature suggests that the adoption of sustainable transport choices at destination may be highly correlated with some previous decisions intrinsically related to the attitudes of the individuals under analysis (Holden, 2009). In this sense, previous evidence states that intra-destination mobility choices are highly determined by the type of destination visited (Gross and Grimm, 2018) and the mode of transport chosen to reach the destination (Doran and Larsen, 2015; Gutiérrez and Miravet, 2016; Miravet et al., 2021a). It has also been found that tourists' decisions on what is visited and the mode of transport to reach an attraction are jointly taken (Masiero and Zoltan, 2013; Le-Klähn et al., 2015: Juschten and Hössinger, 2020). This latter result highlights the importance of implementing effective strategies to foster green mobility at the destination level. Mobility patterns at home also play a role (Zamparini and Vergori, 2021). Therefore, actions pursuing a greener mobility at destinations should be more effective if there is the ability to reach those profiles with a more sustainable behaviour at home, which would lead them to adopt green mobility patterns during their holidays. Consequently, in the present study the following two hypotheses have been raised:

H1. The mobility patterns at home of educated young adults, and so the transport mode choices during the academic year, may be linked to the adoption of green mobility decisions at tourism destinations.

H2. Individual environmental awareness influences both transport decisions to reach the tourist destination and intra-destination modal choices.

H2 has been to some extent previously explored (Gutiérrez and Miravet, 2016; Miravet et al., 2021a), by assuming the existence of different profiles of visitors who are more likely to select certain modes of transport to travel to the destination and certain intra-destination modal alternatives. Though, testing H1 from an econometrical perspective constitutes the main novelty of this paper within the existing literature, whose number of studies that analyse this relationship is scarce (Zamparini and Vergori, 2021).

In the current context of climate emergency and growth of tourism mobilities (although temporarily paralysed by the COVID-19 pandemic), more environmentally conscious tourism-related transport activities may certainly determine a better conservation and attractiveness of the destination which, in turn, may act as a catalyst of tourists' satisfaction and destination competitiveness (Romão and Bi, 2021; Ramkissoon et al., 2013). Thus, this study highlights the need to unravel the determinants of green transport mode choices at tourism destinations as the first step to design adapted and specific transport-related policies. In fact, those individuals that more frequently walk, cycle or use public transport for their regular commuting trips, could do similar choices during their holidays if suitable mobility alternatives were properly promoted.

The paper is organised as follows. Section 2 reviews the existing literature and it aims at identifying the main variables that may impact on the mobility behaviour of tourists at destinations. Section 3 discusses the data that were collected through a questionnaire in 2018. Section 4 presents the empirical approach followed to test the hypothesis and finally selects the bivariate probit models as the most appropriate strategy to estimate the relevance of the various explanatory variables on the green mobility of students at their holiday destinations. Section 5 discusses the results obtained and reviews them within the existing literature. Section 6 presents the conclusions drawn from the study and considers possible future research directions.

2. Review of the literature

An in-depth analysis of the literature has been firstly carried out in order to better frame the research question and the survey design. This section thus reviews the existing literature on tourists' travel behaviour and mode choice determinants, especially for public transport, mainly focusing on green mobility at destination.

The minimization of external costs of transport at the local geographical scale is one of the major challenges policymakers currently confront; this is especially true for tourist destinations, where negative externalities generated by transport, such as landscape and environment deterioration (noise and air pollution), affect the tourists' satisfaction (Hoogendoorn and Fitchett, 2018) and the attractiveness of the destination (Cheng and Wu, 2015; Jarvis et al., 2016). Two main critical issues arise when considering mobility within destination. First, due to the complexity of the multi-sectoral nature of tourism activities - including not only transport but also accommodation, catering, etc. – it is quite uneasy to estimate the specific negative contribution of mobility (Robaina-Alves et al., 2016). Secondly, since transport, like many other tourism activities, is wholly integrated into other physical, behavioural and functional patterns (Gilbert and Clark, 1997), residents share the same infrastructures and premises with tourists. Consequently, and also due to the many differences in modal choice (Malhado and Rothfuss, 2013), motivation and behaviour (Kinsella and Caulfield, 2011; Campos-Soria et al., 2021), it is not easy to assess the role of different determinants in raising external costs such as emissions or congestion. Moreover, the role of the chosen destination (e.g., urban, peripheral, coastal) has been considered by part of the literature (Gonzalez et al., 2019; Caldeira and Kastenholz, 2020). An in-depth review of the literature on the tourists' use of public transport at destinations by Le-Klähn et al. (2015) highlights the differences in its use (and provision) according to rural or urban destinations. In particular, they consider both push (concerning tourist's motives and preferences) and pull (regarding public transport characteristics and provision) factors in order to understand the reasons for its scarce use. They conclude that at the urban scale, who is using public transport is younger, seems also concerned about environment/sustainable mobility, and is more confident about its reliability, while in rural areas they are elder and might be driven by their feeling of insecurity to drive and their willingness to enjoy the journey/trip/travel in terms of landscape and social engagement (Stradling et al., 2007). Moreover, previous works have highlighted the impact of a series of factors on modal choice within destination: a) visitor's demand for control, flexibility and adventure (Butler and Hannam, 2012); b) tourists' identity (Hibbert et al., 2013); c) income level (Jehanfo and Dissanayake, 2009); d) length of travel, with short-haul tourists more likely to use private modes and not to change their behaviour (Reilly et al., 2010); e) transport mode used to reach a determined holiday location (Hergesell and Dickinger, 2013; Le-Klähn et al., 2015), as it appears that long-haul public transport (e.g. trains, buses, ferries) does not only guarantee a better accessibility option for reaching the destination (Masson and Petiot, 2009; Xie, 2013; Wang et al., 2012), but it also enhances greener mobility, promoting public or collective/sharing or slow modes at destination (Wang et al., 2014); f) the availability of modes at destination and the perceived related costs and benefits (Lew and McKercher, 2006).

Another line of research has concentrated on the demographic characteristics of respondents. Hyde (2008) finds car usage for tourism purpose positively correlated with age and negatively with length of stay. Hough and Hassanien (2010), in their research on tourism in Scotland, highlight that country of origin, besides education, language, and previous tourism experience, can be key drivers for the transport mode choice and suggest a further investigation of the impact of activities and holiday expenditure. Becken and Schiff (2011) also identify length of stay, age, travel party relationship, and purpose of travel, as explanatory factors of mode choice. According to Masiero and Zoltan (2013), male tourists and older tourists are more likely to use private

transport (rented or own's vehicles) as well as repeaters, whereas domestic tourists are more likely to use public transport (train or bus) during their stay.

In a previous work, Prillwitz and Barr (2011) examined sustainable transport behaviour in daily routines and on holidays, which turned out to be different, with people caring about their own environmental impact more at home than on holidays. Le-Klähn et al. (2015) examined tourists' day trips in the Munich region using a bivariate probit model, for measuring the impact of tourist personal characteristics, trip characteristics, mode attributes, destination features, and motivations on tourists' mode. According to them, public transport is more likely to be used by younger, well-educated, first-time visitors, who are also price-conscious and do not travel alone. Travel partner and motivations also affect mode choice, while the decision to travel beyond the city is influenced by visitors' country of residence, length of stay, number of previous trips, perception of ease-of-travel (also in terms of efficiency, provision and information on PT), and local attractions. The use of the bivariate probit (Le-Klähn et al., 2015; Masiero and Zoltan, 2013) is justified on the grounds that decisions on what is visited and the mode of transport to move around the tourist destination are jointly taken.

3. Data

Data for this study was gathered from a cross-country survey carried out in September of 2018 to Italian and Spanish university students from the Università del Salento (Lecce, Italy) and the Universitat Rovira i Virgili (Tarragona, Spain). The selection of these two Universities was due to the fact that the authors aimed to compare a homogeneous sample in terms of age and education living in two heterogenous areas. This heterogeneity concerns the proximity of Tarragona to one of the main Spanish cities (Barcelona) while Lecce is in a remote area of Italy. Moreover, the level of service of public transport is different in the two regions. The sampled interviewees were asked about their modal choices during their last holiday trip (regardless of the season in which it took place), along with different control and contextual variables related to the type of trip and the characteristics of the destination visited, their quotidian travel behaviour, and their socioeconomic and demographic attributes. A total of 1275 responses were collected in the largest campuses of both universities. The survey was randomly distributed in paper format in the classrooms of the diverse degrees offered in these campuses (see distribution between knowledge areas in Table 1). A data filtering and debugging procedure was developed, consisting of keeping those responses with answers in all the questions, as well as excluding those responses belonging to students older than 29 years old, those that spent a holiday of >30 days and those that visited the destination accompanied by large groups of >10 people. A total of 979 individual responses, 438 for the Università del Salento and 541 for the Universitat Rovira i Virgili, were regarded as valid, and thus, kept for analysis. These sample sizes are statistically representative of the total number of students of both institutions, as the margin of error with a confidence interval of 95% is lower than 5% in both cases.

Since the main objective of this study is to unravel the determinants of educated young adults adopting green travel behaviour at tourism destinations, the survey asked them how they had distributed their mobility time in their last holiday at the tourism destination visited and on a regular basis during their everyday life. The choice of this variable, which is different from mainstream literature, is justified by the fact that is considered more appropriate when habitual mobility behaviour is considered (Harms et al., 2018). The interviewees had to answer the question providing a percentage of use of different transport modes (on foot, cycling, by public transport, by private vehicle or other type of mode) from 0 to 100%. When the aggregate percentage of use of green transport modes (active transport modes and public transport) was higher than the use of brown transport modes (private vehicle), the variable took the value 1 and 0 otherwise.

The descriptive statistics of the sample can be observed in Tables 1 and 2. Both tables contain two types of variables: discrete variables whose mean and standard deviation are provided, along with dichotomous variables, whose value can be either 0 or 1. On the one hand, in Table 1 are presented the socioeconomic and demographic characteristics of the students surveyed in both cities. The sample is made up

Table 1
Descriptive statistics of the variables related to the characteristics of the university students surveyed ($n = 979$).

Variable	Mean (Std. dev.)
Italian university students from Lecce: Università del Salento	0.447
Spanish university students from Tarragona: Universitat Rovira i Virgili	0.553
Social science and humanities university students	0.774
Sciences university students	0.226
Age	20.147 (2.104)
Gender: Male	0.354
Gender: Female	0.646
Working student	0.279
Only student	0.721
Number of family members	3.866 (0.887)
Monthly income per family greater or equal to €4000	0.138
Monthly income per family between €2001 and €3999	0.497
Monthly income per family lower or equal to €2000	0.365
Ownership: bicycle	0.760
Ownership: other sustainable vehicles	0.180
Ownership: gasoline car	0.858 (0.783)
Ownership: diesel car	0.984 (0.857)
Ownership: hybrid / electric car	0.031 (0.184)
Ownership: motorbike	0.149 (0.429)
Licence: Have a car licence	0.667
Residence while studying: familiar residence ≠ university location	0.237
Residence while studying: leaves familiar residence	0.562
Residence while studying: familiar residence = university location	0.199
Distance between the residence and the university (km)	13.254 (0.51957)
Green transport at home (%)	0.644 (0.358)

Note: All the means of the dichotomous variables must be interpreted as percentages between 0 and 1. The sum of the categories must be equal to 1 except for the variables related to the ownership/availability of vehicles.
Source: Authors' own production.

Table 2
Descriptive statistics of variables related to the holidays and the tourism destination visited by the university students surveyed (n = 979).

Variable	Mean (Std. dev.)
Green transport at tourism destination (%)	0.764 (0.309)
Length of stay (number of overnights)	6.194 (4.416)
Accommodation: friends & relatives	0.239
Accommodation: hotel	0.428
Accommodation: B&B	0.101
Accommodation: apartment	0.185
Accommodation: other	0.047
Party: alone	0.034
Party: family	0.460
Party: partner	0.202
Party: friends	0.304
Travel to destination: private vehicle	0.313
Travel to destination: plane	0.494
Travel to destination: sustainable modes	0.193
Type of holiday: En-route holidays	0.590
Type of holiday: Static holidays	0.410
Type of destination: Rural	0.070
Type of destination: Coastal	0.201
Type of destination: Top international city	0.452
Type of destination: Urban	0.232
Type of destination: Group of adjoining destinations	0.045
Distance between the residence and the tourism destination (km)	1110 (1705)

Note: All the means of the dichotomous variables must be interpreted as percentages between 0 and 1.
Source: Authors' own production.

almost equally between students from Lecce and Tarragona. On the other hand, in Table 2 are shown the statistics of the variables related to the last holidays of the students. The green mobility at the tourism destination is, in percentage, higher than at home.

4. Methods

The dependent variable of the model is whether intra-destination mobility during the holiday is green or not. Given its dichotomous nature, estimation strategy involves a probit model, which takes the following form:

$$p_i = \Phi(X_i\beta) = \int_{-\infty}^{X_{i\beta}} \varphi(t)dt \quad (1)$$

The probability that an individual has intra-destination green mobility is expressed as p_i. X refers to a set of covariates which encompass individuals' travel and stay characteristics along with the fact of having reported a green mobility during the academic period. Φ denotes the cumulative normal distribution function, while φ represents the normal density function.

Besides the aforementioned factors, green mobility at the destination can be the result of individuals' attitudes towards sustainability, which can be reflected according to our research hypotheses by two important explanatory variables of the model: green mobility at the place of residence, along with the mode of transport selected to travel to the destination. In this sense, it could be hypothesized that these unobserved attitudes can affect mobility at home and holidays alike, which would raise a concern related to a potential endogeneity bias. Also, as a result of individuals' environmental awareness, the mode of transport chosen to travel to the destination can also emerge as a potential source of bias if it is conditioned by unobserved attitudes towards sustainability.

A third potential source of bias, which does not involve sustainability awareness, points towards the relationship between what is visited at the destination and the intra-destination modal choices (Masiero and Zoltan, 2013; Le-Klähn et al., 2015). The concern stems from the fact that those places visited during the holidays are determined by the modal alternatives which are available to visit them, and subsequently, the modal choices are determined by the decision of the place that is going to be visited.

On top of that, it must be also considered that, if the models are non-linear, the use of traditional linear instrumental variables techniques to deal with endogeneity will result in inconsistent results (Wooldridge, 2014). Thus, since the dependent variable (green intra-destination mobility) is dichotomous, different empirical approaches to discern whether endogeneity is an issue that needs to be addressed are adopted contingent on the characteristics of the variables suspected to cause a bias. Given the questions of the survey related to the choice of the modes of transport, alternative scales for the dependent variables could have been used, for instance a 0 to 1 scale. Nonetheless, this sort of scale would have prevented the implementation of proper methodologies to tackle endogeneity.

4.1. Endogeneity associated with green mobility at home and decisions regarding visiting places from the destination

Green mobility at home is an indicator variable, whose values equal 1 (green) or 0 (not green). Likewise, the variable that indicates whether the individual restricts his/her visits to the attractions of the city or town where he/she lodges, together with the variable that signals whether intra-destination mobility is green or not, are also dichotomous. The effect of the potential correlation of the unobserved heterogeneity associated to two different dichotomous variables can be tackled by means of a bivariate probit (O'Higgins, 1994).

The use of this sort of model in tourism research is not new. For instance, Eugenio-Martin and Campos-Soriac (2010) already applied the bivariate probit model to conclude that usual better meteo conditions in the place of residence are associated to a higher propensity of domestic travels and a lower probability of travelling abroad, being both latter variables mutually related. In the context of intra-destination modal choices, it has also been used by Masiero and Zoltan (2013) and Le-Klähn et al. (2015) to circumvent endogeneity bias. According to Masiero and Zoltan (2013), tourists, regardless of whether their decisions are sequential of simultaneous, jointly decide what they are visiting (where they go) and how they get there (modal choice). Both works confirmed this hypothesis. Tourists' intra-destination sustainability of modal choices must be thereby jointly modelled with decisions regarding what is visited during the holiday stay. Thus, the joint specification of the relationship between the probabilities of having a green intra-destination mobility during the holiday and whether the tourist remains at the tourist destination where is located his/her lodgement (static holidays) can be expressed as follows:

$$y_{i1}^{*} = \beta_1' X_{i1} + \varepsilon_{i1}, y_{i1} = 1 \; if \; y_{i1}^{*} > 0, 0 \; otherwise$$

$$y_{i2}^{*} = \beta_2' X_{i2} + \varepsilon_{i2}, y_{i2} = 1 \; if \; y_{i2}^{*} > 0, 0 \; otherwise$$

$$[\varepsilon_{i1}, \varepsilon_{i2}] \sim N_2 \; (0, 0, 1, 1, \rho), \; -1 < \rho < 1 \quad (2)$$

y_{i1}represents the individual observations of whether subject i reported a green intra-destination mobility during the holiday. y_{i2} refers to static holidays. y_{i1}* and y_{i2}* represent respectively their associated latent variables. β_1' and β_2' denote the vectors of coefficients, X_{i1} and X_{i2} express the set of the observed explanatory variables, while ε_{i1} and ε_{i2} are the unobserved heterogeneities of each of the equations (error terms).

Analogously, the endogeneity concern also rises for green mobility during the academic course, which is also a dichotomous variable. It must be taken into consideration that modal choices both at home and the tourist destination can be shaped by individuals' environmental awareness, which is an unobserved variable. In the event that both variables are indeed determined by individuals' environmental consciousness, the error terms of each of the expressions are likely to be highly correlated, which would result in an endogeneity bias. Thus, the use of the bivariate probit is again required. In a similar vein, Falk and Hagsten (2019) already used the bivariate probit model to model tourists' decisions which are influenced by environmental awareness. Their analysis jointly estimated the determinants of destination and transportation preferences.

In our case, expression (2) is valid again, where y_{i1}represents the individual observations of whether subject i reported a green intra-destination mobility during the holiday and y_{i2} refers to having reported a green mobility at the place of residence during the academic course. The rest of the symbols have the same interpretation as previously described.

The use of the bivariate probit is justified as long as the correlation between ε_{i1} and ε_{i2}, represented by ρ, is significantly different from 0. For this reason, the null hypothesis of exogeneity ($\rho = 0$) is tested by implementing a Wald test. The probabilities of $\rho = 0$ are respectively 0.037 when the variable suspected to be endogenous is green mobility at home, and 0.0002 for the case of static holidays at the destination. As a result, exogeneity is rejected and the estimation of the bivariate probit is supported in both cases, confirming the first two hypotheses of this study.

The set of independent variables that accounts for the probability of being green during the holiday include individuals' characteristics, characteristics of the holidays, transport used to travel to the destination, as well as ownership of different sorts of vehicles. The observed determinants of the probability of a green mobility during the academic course comprise the same individual characteristics and ownership of vehicles as in the previous equation, along with the characteristics of the higher education studies coursed by the individual.

4.2. Endogeneity associated with transport to the tourist destination

Given that individuals can choose more than two modes of transport to travel to their tourist destinations, the bivariate probit is no longer suitable to cope with potential endogeneity. The multinomial nature of the variable which is suspected to be endogenous and the dichotomous nature of the dependent variable leads to the methodology suggested by Deb and Trivedi (2006a, 2006b). According to this estimation technique, latent factors are introduced into the multinomial and logit equations. This methodology has also been applied by Gutiérrez and Miravet (2016) and Miravet et al. (2021a) to analyse the determinants of intra-destination use of public transport by tourists with opposite results.

Following the aforementioned authors, the probability of choosing each of the modes of transport (plane, private vehicle and public transport) to reach the tourist destination can be expressed as follows:

$$Pr(m_i|z_i, l_i) = \frac{exp\left(z_i^{'}\propto_j + \delta_j l_{ij}\right)}{1 + \sum_{k=1}^{J} exp\left(z_i^{'}\propto_k + \delta_j l_{ik}\right)} \quad (3)$$

where the probability of an individual i selecting a transportation mode j is a determined by a set of observed covariates z_i and a group of unobserved variables l_{ij}. δ_j represents the loading factor associated with each of the transport alternatives.

The probability of having green intra-destination mobility is defined as:

$$Pr\left(y_{i,}|x_i, m_i, l_i\right) = \frac{exp\left(x_i^{'}\beta + \sum_{j=1}^{J}\gamma_j m_{ij} + \sum_{j=1}^{J}\lambda_j l_{ij}\right)}{1 + exp\left(x_i^{'}\beta + \sum_{j=1}^{J}\gamma_j m_{ij} + \sum_{j=1}^{J}\lambda_j l_{ij}\right)} \quad (4)$$

where the probability of an individual i opting for a sustainable mobility during their stay at the destination is determined by the set of covariates x_i, the transportation mode selected to travel to the tourist destination m_i and the unobserved heterogeneity l_{ij} with their respective loading factors λ_j. The impact of unobserved heterogeneity related to each of the transport alternatives to travel to the destination is given by λ_j.

Following the exogeneity test suggested by Deb and Trivedi (2006b), the null hypothesis of all $\lambda s = 0$ (λprivate vehicle=λpublic transport = 0; being plane the base category) is tested. The probability derived from the performance of the test is 0.27. Thus, exogeneity cannot be rejected, and the implementation of the methodology conceived by Deb and Trivedi (2006a, 2006b) is not supported.

Observed explanatory variables of the outcome Eq. (4) comprise the university to which the student belongs, gender, ownership of a driving licence, as well as characteristics of the holiday: whether the student stayed at the same location during the whole stay or whether moved around a diversity of locations, travel party, accommodation, length of stay, type of destination, and green mobility during the academic course. The set of independent variables used to perform the mixed multinomial logit model presented in Eq. (3) embrace the university to which the student belongs, the log of the distance to the destination, hotel accommodation, income, green mobility during the academic course, driving licence ownership and gasoline car ownership. These estimations restrict the number of explanatory variables with the object of ensuring the convergence of the models that allows the subsequent performance of the endogeneity test.

5. Results and discussion

Table 3 presents the results of two bivariate probit models. Model 1 assesses endogeneity between reporting intra-destination green mobility during the holiday and during the academic course, while Model 2 explores endogeneity between reporting intra-destination green mobility during the holiday and having a static holiday.

Model 1 considers green mobility at home as the source of the endogeneity bias. For this reason, this variable becomes the dependent variable of the second equation of the model. Analogously, Model 2 takes the indicator variable "static holiday" as the endogenous one. The rejection of the null hypothesis of exogeneity is supported in both models by the correlation of the disturbance terms, ρ, which emerges positive and statistically significant in models 1 and 2. Besides, the explanatory power of these variables is pinpointed by the fact that Model 1 presents a positive and highly significant coefficient associated with static holidays, and the positive and also significant coefficient attached to be green at home in Model 2. The impact related to having a static/dynamic stay concurs with the conclusions drawn by Masiero and Zoltan (2013) and Le-Klähn et al. (2015), which highlighted the intimate connection between the decisions of visiting attractions from the tourist destination and subsequent modal choices. In similar grounds to urban residents' mobility, if the tourist intends to merely move around the destination where he/she is lodged, mobility is more likely to be satisfied by means of the sustainable modes of transport. On the contrary, the intention of reaching further locations requires the use of motorised transport, unless it is a trekking or cycling route. The most remarkable result because of its novelty is given by the other variable that is suspected to be endogenous: green mobility at home. Evidence reveals a significant positive relationship with green intra-destination mobility, together with the fact that the unobserved heterogeneities attached to the modal choices at home and during the holidays are correlated. This result that connects both mobilities is consistent with H1, and is particularly interesting in the context of previous scarce evidence regarding this issue. The factors underlying unobserved heterogeneity remain uncertain, nonetheless. It could be hypothesized that individuals committed to sustainability in their mobility decisions at home, behave likewise when they are on holidays. A second possible reasoning signals a mere matter of custom. At this stage, it is not possible to disentangle this issue. Hence, it will have to be properly addressed by future research.

Even though no evidence of endogeneity bias related to the mode of transport selected to travel to the destination has been found (H2 rejected), the probability of having green intra-destination mobility is highly determined by this variable. This has been previously highlighted by Dolnicar et al. (2010), Bieland et al. (2017), Gross and Grimm (2018), Gutiérrez and Miravet (2016) and Miravet et al. (2021a). The negative, large and highly significant coefficient associated with reaching the destination by car implies a considerable effect attached to this variable both in Models 1 and 2. The likelihood of being green at the destination substantially declines if the tourist has travelled there by means of the private vehicle, in comparison to the train or the public transport. The reason is grounded in the subsequent availability of a private car at the destination to move around. Focusing on hypothesis H2, the lack of evidence of correlation between the unobserved heterogeneity attached to travel-to-destination modal choices and intra-destination modal choices opposes to the existence of an environmental awareness that affects both variables alike. Previous evidence regarding this issue is mixed. Miravet et al. (2021) also found a lack of correlation between the residuals of both variables. On the contrary, Gutiérrez and Miravet (2016) indeed reported significant correlation, and thus, the existence of endogeneity. Though, this latter work concluded that unobserved heterogeneity was associated to the existence of different profiles of visitors with different tastes regarding how active they were undertaking the visit of tourist attractions at the destination.

With respect to the rest of the variables, the results of models 1 and 2 mostly concur. According to both models, male gender, coastal destinations and car ownership lead to more unsustainable mobility at the destination. In contrast, the students from Lecce and those visiting top international destinations are more likely to present "greener" intra-destination mobility. In the case of tourists from Lecce, the reason of this result may be related to a lower level of service of public transport in their area. The coefficient of the length of stay is positive and significant only in Model 1, while to travel with family members exerts a negative

Table 3
Bivariate Probit estimations.

	Model 1				Model 2			
	Green during holidays		Green at home		Green during holidays		Static holiday	
	Coefficient	Robust Standard Error	Coefficient	Robust Standard Error	Coefficient	Robust Standard Error	Coefficient	Robust Standard Error
Interecept	−1.3993	(3.92)	2.0411	(3.61)	−1.7051	(3.96)	−3.1685	(3.68)
Lecce	0.3368	(0.13)***	−0.2817	(0.12)**	0.4259	(0.12)***	0.6503	(0.1)***
Age	0.2592	(0.36)	−0.2026	(0.33)	0.2986	(0.36)	0.4161	(0.34)
Age^2	−0.0067	(0.01)	0.0024	(0.01)	−0.0075	(0.01)	−0.0100	(0.01)
Male	−0.2422	(0.11)**	−0.2008	(0.1)**	−0.2123	(0.11)**	0.0504	(0.09)
Working students	0.0900	(0.12)	−0.0087	(0.11)	0.0862	(0.12)	−0.0595	(0.11)
Income<2000€	0.0875	(0.12)	0.1537	(0.11)	0.0841	(0.12)	0.0527	(0.1)
2000€ < Income<4000€	Reference category		Reference category		Reference category		Reference category	
Income>4000€	0.1129	(0.16)	0.0074	(0.14)	0.0895	(0.16)	−0.1887	(0.14)
Family members	−0.0107	(0.06)	0.1081	(0.06)*	−0.0232	(0.06)	−0.0423	(0.05)
No driving licence	−0.003	(0.13)	0.6523	(0.13)***	−0.0535	(0.14)	−0.0447	(0.12)
Static holiday	0.4170	(0.12)***						
Party: friends	Reference category				Reference category		Reference category	
Party: family	−0.2260	(0.14)			−0.2659	(0.14)*	−0.3207	(0.11)***
Party: alone	0.0183	(0.31)			0.0433	(0.31)	0.1846	(0.25)
Party: partner	−0.1181	(0.16)			−0.1376	(0.15)	−0.155	(0.13)
Accommodation: hotel	Reference category				Reference category		Reference category	
Accommodation: apartment	−0.1748	(0.14)			−0.1587	(0.14)	0.1201	(0.13)
Accommodation: B&B	0.3761	(0.24)			0.345	(0.24)	−0.1915	(0.15)
Accommodation: friends & relatives	−0.5229	(0.13)***			−0.533	(0.13)***	−0.1415	(0.12)
Accommodation: other	0.3678	(0.25)			0.3105	(0.25)	−0.6166	(0.31)**
Length of stay	0.0199	(0.01)*			0.0163	(0.01)	−0.0308	(0.01)**
Log distance to destination	0.0040	(0.13)			−0.042	(0.13)	−0.3542	(0.12)***
Urban destination	Reference category				Reference category		Reference category	
Coastal destination	−0.3020	(0.15)**			−0.3595	(0.15)**	−0.4193	(0.15)***
Top international destination	0.2737	(0.15)*			0.3376	(0.14)**	0.4905	(0.12)***
Rural destination	0.1547	(0.21)			0.0887	(0.2)	−0.56	(0.22)**
Group of adjoining destinations	−0.2576	(0.24)			−0.2999	(0.24)	−0.6214	(0.31)**
Travel: plane	Reference category				Reference category		Reference category	
Travel: private vehicle	−0.7339	(0.15)***			−0.7131	(0.15)***	0.0876	(0.14)
Travel: sustainable modes	0.1857	(0.17)			0.1835	(0.17)	−0.0053	(0.13)
Ownership: motorbike	0.0245	(0.13)	−0.3563	(0.11)***	0.0464	(0.13)	0.0347	(0.11)
Ownership: gasoline car	−0.2434	(0.12)*	−0.1535	(0.11)	−0.238	(0.12)*	−0.0852	(0.1)
Ownership: hybrid / electric car	−0.2868	(0.27)	−0.7594	(0.27)***	−0.2175	(0.27)	0.1479	(0.26)
Ownership: diesel car	−0.0860	(0.13)	−0.3706	(0.12)***	−0.0514	(0.13)	0.0415	(0.11)
Ownership: bicycle	0.2040	(0.12)	−0.0670	(0.12)	0.1793	(0.12)	−0.2263	(0.11)**
Ownership: other sustainable	−0.0314	(0.09)	−0.0061	(0.1)	−0.0443	(0.09)	−0.1218	(0.09)
Social sciences			0.3764	(0.14)***				
Residence: familiar residence ≠ university			Reference category					
Residence: familiar residence = university			1.4497	(0.27)***				
Residence: leaves familiar residence			2.0613	(0.28)***				
Log distance from the residence to the university			0.425	(0.08)***				
Green at home					0.2296	(0.12)*		
	Coefficient		Robust Standard Error		Coefficient		Robust Standard Error	
Rho	0.1515		(0.0731)		0.2585		(0.0671)	
/Athrho	0.1526		(0.0713)**		0.2645		(0.0719)***	
	Variables included in each model							
Individual characteristics	X		X		X		X	
Holiday characteristics	X				X		X	
Mode of transport to travel to the destination	X				X		X	
Vehicle ownership	X		X		X		X	
University education characteristics			X					
Static holiday	X							
Green at home					X			
Observations	979				979			
Log-likelihood	−876.66451				−947.31778			
Wald test (H_0: rho = 0)	$\chi^2(1) = 4.36555$; $p < 0.0367$				$\chi^2(1) = 13.5482$; $p < 0.0002$			
AIC	1859.329				2022.636			
BIC	2118.315				2335.374			

Note: * Significant at 10%, ** significant at 5%, *** significant at 1%. Robust standard errors within parentheses.
Source: Authors' own production.

significant impact according to Model 2. In both cases, the degree of significance is weak.

Given that the specifications already control for the ownership of a driving licence, which does not yield a significant effect in any of the models, and motorised vehicles, which reduces the likelihood of a green mobility at the destination, the significant coefficient associated to gender might be underlying something different than a lower percentage of women who drive. This might involve divergent preferences by gender related to what is visited and how is visited. In tune with Gross and Grimm (2018), the type of destination is a significant determinant of intra-destination modal choices. It must be taken into consideration that the accessibility to attractions from the place where the visitor lodges is crucial to determine modal decisions (Gronau and Kagermeier, 2007), and this is very influenced by the type of destination that is being visited. The implications of longer lengths of stay are twofold and opposed to each other. On the one hand, they are likely to trigger the demand for motorised modes of transport, as the potential number of attractions that can be visited during the whole stay grows, and so does distances covered to fulfil visitors' demand (Gutiérrez and Miravet, 2016). Conversely, and as Model 1 appears to reflect, longer stays might lead to more relaxed holidays, with several days staying at the city or town where the accommodation is located. As a result, there is a decrease on the average need of more pollutant modes of transport. The evidence of lesser sustainable mobility attached to familiar travel parties shown in Model 2 might be associated with the pursuit of a higher degree of comfortability by families while travelling. Factors which were found to be significant predictors of intra-destination modal choices in previous research such as age (Le-Klähn et al., 2014), or income level (Gross and Grimm, 2018) are not significant in any of the models.

Even though it is not the main object of the present paper, the determinants of being green at home, and static mobility at the destination deserve to be commented too. With respect to the factors of being green at home (Model 1), the place where the student resides during the academic year is the most powerful predictor. Those students who leave their familiar home to study are the most sustainable ones, followed by those students who stay at home but live in the same city where their faculties are located. In the same vein, the shorter the distance from the residence during the academic period to the faculty, the “greener” students' mobility is. In accordance with Balsas (2003), students who are settled relatively near to their faculties during the course tend to be less dependent on motorised transports. Moreover, those students who change residence during the course are less likely to have an available car. The ownership of private motorised vehicles also plays a key role, and lead to less sustainable mobility, even in the case of hybrid or electric vehicles. On the contrary, bicycles do not yield a significant effect. The lack of a driving licence appears to be a deterrent of motorised private transport at home, while it is not at the tourist destination. The reason may lie in the fact that while holidays frequently involve travelling in group, and the ownership of a driving licence by a member of the party group suffices their mobility needs, commuting is more likely to be individual. Males are less sustainable at home and at the destination alike. Conversely, the sign of the effect attached to the origin of the students reverses, and the students from Lecce are significantly less sustainable during the course. This variable might be capturing a different degree of accessibility to the university campus for each of the modes, which is one of the main determinants of students' modal choices (Delmelle and Delmelle, 2012). Finally, while income does not yield a significant effect, the positive significant coefficient associated with the number of family members appears to pinpoint restrictions to car availability.

Regarding the factors that account for static/dynamic holidays (Model 2), results make apparent that the type of destination causes the greatest impact. As expected, those trips that visit a whole region entail a higher degree of intra-destination mobility, followed by rural and coastal destinations. On the contrary, tourists who travel to top international destinations tend to remain in the same place. Length of stay and the distance travelled to the destination enhance the degree of intra-destination mobility. As commented previously, longer stays are associated with an extended number of places and attractions visited, whereas longer distances travelled to the destination prompt tourists to augment the size of the territory they are visiting. The students from Lecce, who present a higher probability of having green intra-destination mobility, are also more likely not to move from their destination. Familiar travel parties and individuals who own a bicycle present a lower probability to remain at their destination during the holidays. Finally, no significant effect stems from the mode of transport used to travel to the tourist destination.

Evidence found is of high interest in a context of high competitiveness between destinations where active modes, mainly walking but also cycling and public transport are key to foster their attractiveness, whilst environmental and mobility problems can seriously damage the destination's reputation (Becken et al., 2017; Eusébio and Vieira, 2013). Destination managers must be conscious that a lesser dependence of their visitors on the private vehicle is associated with a higher space devoted to walking, which is assumed to be the most appropriate way of moving around and obtaining the best experience of the place visited (Ram and Hall, 2018). Regarding public transport, the existence of a powerful network that covers the whole tourist area results in a wider range of attractions which are accessible to visitors (Miravet et al., 2021a). As a result, the level of competitiveness of the destination rises as it is able to offer to the visitor a larger set of visiting options, which also has positive implications in terms of enhancing the length of stay (Miravet et al., 2021b).

In this vein, our results highlight the tight relationship between mobility decisions at the destination and the length of stay. This relationship is highly determined by having a static or dynamic stay in terms of moving around. As stated in the previous paragraph, longer stays give the chance to the tourist to visit more attractions and places, and thus increasing the likelihood of having a more dynamic holiday. At the same time, the longer the stay, the larger the chances that the tourist chose greener mobility options as walking or public transport are more likely to become suitable mobility options if visitors have a large number of days to undertake their visits. Thus, longer lengths of stay do not only make travel to destination more sustainable (Gössling et al., 2018), but they also contribute to both the sustainability and the competitiveness of the tourist destination. This effect is at least partially counteracted by the effect the positive impact of static holidays on the likelihood of having green mobility choices at the destination. This latter result is accounted for the fact that the private vehicle is likely to be chosen to move around the destination and reach a larger number of attractions visited. Travel party is also a critical element. Families travelling with children look for comfortability, and hence, the private vehicle becomes the most preferred choice for many of them. In turn, this contributes to more active and mobile stays. The size of the group is less important, as no significant effects compared to “solo” travellers emerge from travelling with friends.

The main novelty of the present study lies in the fact that in opposition to previous works which found no connection between the role that sustainability plays at home and during the holiday when determining individuals' decisions (Anciaux, 2019), a positive and significant relationship has been found. It persists even when the models include control variables such as income. In terms of policy implications, it is a substantial result, as it is giving an insight of the importance of promoting sustainable modes of transport not only for commuting travel, but also for the mobility at destination. In this sense, destination managers must be aware that tourists' decisions in terms of mobility choices can be permeable to changes in the distribution of the public space between modes of transport, improvements in the number of attractions / places that can be reached by means of public transport, and restrictions to the use (and parking) of the private vehicle. In this sense, it is essential to ensure that the information properly arrives to the visitor. Destination managers must ensure that the communication channels are the

appropriate ones to convey the information, and at the same time, information must be easy to comprehend. The planning and implementation of ASI (Avoid – Shift – Improve) schemes (Banister, 2011), which sequentially pursue a reduction of the more pollutant modes of transport, the shift to the more sustainable ones, and finally, a higher degree of efficiency of the motorised vehicles, can also help to constitute successful tourist destinations. At least, in terms of the "avoid" and "shift" parts, given that the capacity of the tourist destination to have an influence on the latter will be very limited.

Finally, consistent with previous research (Gutiérrez and Miravet, 2016; Bieland et al., 2017) we have obtained evidence that signals that transport mode choice to the destination is critical to determine intra-destination modal choices. In fact, it emerges as one of the most powerful predictors. In contrast, we have not obtained evidence of the connection of the unobserved heterogeneity of green mobility at home and transport choices to the destination. This result implies that the travel to the destination would not be affected by individuals' environmental concerns since the willingness of visiting a certain place would be a more decisive factor. It is a worrisome result as the travel to destination yields the highest proportion of greenhouse gas emissions (Rico et al., 2019; Peeters and Dubois, 2010).

6. Conclusions

This study aimed to identify the determinants of green mobility choices taken by educated young adults during their holidays at tourism destinations by means of a cross-country survey. The contribution of the study is therefore framed within the existing literature about the propensity of young people to adopt environmentally responsible behaviour (Kiatkawsin and Han, 2017; Suchanek and Szmelter-Jarosz, 2019), concretely within the field of transport choices at tourism destinations (Le-Klähn et al., 2015; Gutiérrez and Miravet, 2016; Miravet et al., 2021a; Zamparini and Vergori, 2021). The novelty of this study and its contribution to this stream of literature is three-fold. First, it has considered the transport mode choices at a whole range of different tourist destinations of two subsamples of educated young people who in their corresponding home regions share the same transport infrastructures and options. Secondly, it has considered the mobility time to build the dependent variable, differently from most of the literature. This choice has been justified by the fact that asking about the time spent using the different transport modes is a more appropriate method when the analysis also takes into account habitual travelling behaviour (Harms et al., 2018). Thirdly, the present study has involved the development of a methodology that should be considered when developing studies on transport modal choices, since transport decisions are intrinsically related to unobserved attitudes towards sustainability of the individuals under study. We have tested two hypotheses that have been derived from the analysis of the existing literature, about the potential existence of endogeneity between the dependent variable (the green mobility at tourism destination) and two independent variables (i.e., the mobility choices at home; and the type of transport mode used for the longest haul from the origin to the destination), due to a correlation with the unobserved attitudes of the individuals under analysis towards the adoption of green mobility choices. Besides, and based on previous research, endogeneity regarding the type of holiday depending on whether they are static or involve visiting more than one destination, has also been treated as an econometric concern.

Regarding the first variable/hypothesis, previous research stated that pro-environmental behaviour may vary according to the context at home or at tourism destinations (Barr and Prillwitz, 2012; Prillwitz and Barr, 2011). The existing studies have hypothetically stated that doing holidays out of the daily life context could push tourists to adopt less environmentally friendly modes of transport than when they are at home (Kiatkawsin and Han, 2017; Miller et al., 2015). On the contrary, our study has empirically demonstrated that there is a high correlation between the patterns and behaviours of educated young adults at home and those adopted during holidays at tourism destinations. On top of that, the relationship between the dependent variable and the mobility choices taken during their academic year by the young university students under study is endogenous. Thus, the first hypothesis has been confirmed.

Regarding the second variable/hypothesis, in line with the results obtained by Miravet et al. (2021a), the hypothesis has been rejected, as the endogeneity has not been demonstrated with the type of transport used to reach the tourism destination. Notwithstanding, reaching the destination by means of private vehicles is negatively associated with the use of sustainable transport modes once at destination. Therefore, future research should analyse how to encourage tourists to abandon their private vehicles once they arrive at destination and implement tailor-made strategies to promote the sustainable mobility (Peeters and Schouten, 2006).

Finally, the study has also confirmed and evidenced the existence of an intrinsic relationship between the dependent variable and the type of holiday undertaken regarding the dynamism of visits: whether the tourist decides to stay at a fixed destination or opts to visit other places. This suggests that not only the type of destination must be considered when we try to disentangle the factors pushing tourists to use sustainable transport modes, but also the degree of connectivity between attractions and destinations should be analysed. This could help to implement strategies to foster the use of more sustainable modes of transport among tourists.

The present work in not exempt from some limitations. First, it is not possible to conclusively assert whether the correlation between the unobserved heterogeneity of green mobility at home and at the tourist destination is related to individuals' environmental awareness. Since the specification of our models allows controlling for the availability of a driving licence and car ownership, it seems less likely that results reflect a mere matter of custom of those students who do not use the private vehicle because they do not have usual access to it. It cannot be discarded nonetheless that more environmentally conscious individuals at home could be less environmentally concerned during their holidays, and simply use the public transport because they are used to it. Future contributions in this field should be able to incorporate additional indicators that effectively capture environmental awareness regarding mobility. Second, the sample used is restricted to educated young adults studying in two Southern-European universities. Even though the object of this study pursues to unveil the factors that determine mobility choices during their stay at the tourist destination of young well-educated adults, results can be conditioned by the profile of student of the two institutions where the survey took place.

The context and the results of this paper allow us to suggest some possible future research directions. First, it would be desirable to create more disaggregated categories related to the type of destinations visited by the students. We have detected that the visit of top international destinations is highly associated with a higher use of greener transport modes, whilst the contrary effect has been detected on the visits to coastal destinations. The characteristics of the destinations (with respect to indicators of compactness, diversity of tourism attractions, connectivity between points of tourist interest, existence of infrastructure promoting cycling and walking, supply of public transport, among others) are diverse. Hence, future studies may concentrate on analysing a limited number of destinations of different type and explore the effect of the destinations' characteristics along with the impact of 'push' factors (which prompt tourists to abandon motorised transport modes and switch to more sustainable alternatives) and 'pull' factors (which involve actions that would make sustainable modes more attractive) on tourists' modal choices. Second, the relationship between the satisfaction of the tourists with their holidays and their transport modal choices should also be investigated. Previous research has demonstrated that the use of collective transport modes has a higher contribution to trip satisfaction than entertainment or shopping environments (Romão and Bi, 2021). Therefore, more efforts should be put forth to reinforce the

supply of sustainable modes of transport and to improve the quality of the built environment. This would promote the adoption of environmentally friendly patterns of mobility among tourists and it would also enhance their trip experience and satisfaction. Third, the analysis can be spread to other segments of population: non-university-student educated young adults, and older individuals. Finally, in the post-pandemic scenario, which coincides with the imminent need to face the challenges of climate change, the analysis of the effects of the pandemic on the attitudes of people towards the adoption of sustainable mobility practices is even of more paramount importance (Gutiérrez et al., 2021). The propensity or reluctance to use public transport and/or opt for active mobility is subject to the socioeconomic profile of the individuals and the characteristics of the places, but also to conjunctural events that affect the perception (e.g., the fear of contagion). Therefore, further investigation in this research field is necessary to then establish solid policies for the reduction of the ecological footprint associated with travel and mobility in general, and for the advancement towards a sustainable tourism development specifically. In this context, this study proposed the results concerning a cross-country sample of educated young people. Such results are of the utmost importance for policy makers as these people will constitute an important share of the population in the coming decades. Moreover, their mobility patterns may, in the long run, influence those of the future generations, determining a virtuous circle of environmentally friendly mobility patterns that may lead to sustainable transport at all levels (local, national, and international).

CRediT authorship contribution statement

L. Zamparini: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **A. Domènech:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **D. Miravet:** Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **A. Gutiérrez:** Funding acquisition, Investigation, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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