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Visitors' Attitudes towards Bicycle Use in the Teide National Park

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Abstract: Few studies have examined visitor preferences with regard to public bike-sharing inside national parks. Here, we present a case study of the Teide National Park (TNP), the most visited national park in Spain. The TNP is a clear example of a natural site suffering the effects of mass tourism, largely due to the fact that 70% of visitors access the TNP by car. This puts the park's sustainability under considerable pressure, may well affect visitor enjoyment, and highlights the need to implement alternative transportation systems. The main aim of this paper is to assess the attitudes of visitors to the TNP towards the implementation of a public bike-sharing system. To do so, we combine information on revealed and stated preferences and estimate ordered logit models to establish the determinants of the propensity to choose the bicycle to move around the park. Our findings suggest that the bicycle has potential as a means of transport in this setting. The results have implications for the design of mobility management measures aiming to increase visit quality and reduce the negative externalities associated with mobility patterns in national parks.

Keywords: revealed/stated preferences; ordered logit models; odds ratios; alternative transportation systems; bicycle; Teide National Park

1. Introduction

The use of bicycles by tourists has increased rapidly in Europe in recent years. The rise in cycle tourism is also reflected in the growing number of national parks in which bicycles are permitted. In the UK, there are numerous examples (the Cairngorms, Pembrokeshire Coast, Dartmoor, Loch Lomond and the Trossachs, the Peak District, the New Forest, Exmoor, and so on). In the US, the national parks offering bicycle rentals include Grand Canyon, Acadia, and Valley Forge. In fact, the first national park to offer bike-sharing was De Hoge Veluwe in the Netherlands, which started its "white bike" scheme in 1975 [1]. The growth of the white bike fleet reflects the public's positive attitudes towards using a bicycle during their visits to the park.

National park management units in several countries have introduced bike sharing as a subtle way to dissuade visitors from using private vehicles. These experiences have brought notable benefits: social (i.e., the promotion of a healthy environment for the population and reduction in medical costs), environmental (the reduction in the impact on natural resources and the environment), economic and industrial (bicycle manufacturing companies), and political (the creation of jobs due to the growing demand for bicycles and promotion of the tourist market). In addition, in the parks mentioned above, the bicycle is not just regarded as a means of transport, but has become an integral part of the tourist experience itself.

Although bike-sharing has received increasing attention in recent years, empirical studies examining the practice as a sustainable means of transport in natural and protected areas are few and far between. Proposals to increase cycling tend to focus on urban rather than rural environments [2–5]. In natural parks, the majority of studies have focused on visitor surveys regarding changes in management policy. Using a Stated Preferences (SP) experiment and discrete choice models, Kohlhardt et al. found that crowding at viewpoints is a particularly important issue for visitors [6]. Using qualitative surveys, Hallo and Manning stressed the need to adapt road management in natural parks, since visitors respond differently to variables such as crowding, speed and scenic value [7]. Asking willingness-to-pay questions and using regression analysis, Phillip and MacMillan found that the majority of visitors are supportive of parking fees as long as the money is reinvested in visitor facilities and environmental preservation [8].

Other studies, more in line with our approach, have analysed visitors' preferences regarding alternative transportation systems. Using SP surveys, Pettebone et al. found that visitors prefer to use their private vehicles but would be willing to change to ATS under certain conditions of trail crowding and road congestion [9]. Through qualitative and quantitative surveys, Holly identified frequency and waiting time as the most important factors in the use of a park-and-ride shuttle bus [10]. Taff et al. also evaluated preferences for shuttle buses using factor analysis [11], and identified three incentive factors: ease (i.e., safety, easier displacement and pleasant interactions with other visitors); freedom (i.e., ease of access to different areas and viewpoints); and stress (i.e., crowding, parking problems and congestion). Finally, using a SP questionnaire and discrete choice models, Pettengill et al. evaluated attitudes towards car, shuttle bus and bicycle transport modes; they found that visitors preferred segregated bike lanes, lower levels of crowding and travel costs, and greater convenience in the form of parking lots, bicycles and bus stop availability [12].

As far as we know, no previous studies have measured the propensity to choose a bicycle in a national park using information both from revealed preferences regarding the choice of travel mode for accessing the site and from stated preferences regarding the intention to switch to a new internal shuttle bus. This paper aims to fill the research gap in visitor preferences on public bike-sharing in natural environments and to contribute to the growing body of knowledge regarding the assumptions underlying the issue of tourism mobility [13].

The setting for the study is the Teide National Park (TNP), the most frequently visited national park in Spain. The TNP is a natural area experiencing the effects of mass tourism; there is a clear imbalance in transport modes, as 70% of visitors access and move around the park by car, mainly rental cars. Regular public transport is used by only 2% of visitors, and another 30% access the park in tourist buses as part of excursions included in a tourist package. In this context, the use of bicycles along the park's roads is practically non-existent, although certain elite cycling teams come to the park to train.

Thus, the current mobility patterns of TNP visitors are generating a series of external effects that jeopardize the park's sustainability and may reduce visitor enjoyment. The problems caused include the saturation of car parks, traffic congestion on the road that passes through the park at certain peak hours, greenhouse gas emissions, noise pollution, and so on. To reduce these negative impacts, mobility management policies are needed that promote other more sustainable modes of transport—among them the bicycle, which is one of the most recognized modes of sustainable mobility. To properly assess alternative management strategies, studies of transport behaviour are mandatory.

The objective of this paper is to analyse visitors' propensity to use bicycles in the TNP if a public bike-sharing scheme is implemented. To do so, in July 2016, an SP choice experiment and an RP survey were administered to 801 and 602 park visitors, respectively. The econometric model used is the ordered logit model, in which the dependent variable, the degree of preference for using bicycles in the park, was presented in an orderly manner in different categories. Several specifications are considered, including socioeconomic variables that define the visitor's profile and variables associated with the characteristics of the trip. The results provide information about the influence of specific aspects on the potential demand for cycling among visitors, such as the mode of transport they choose to access the park, their socioeconomic characteristics, and their attitudes towards using an internal bus inside the park. Furthermore, the results help to predict the willingness of visitors to use bicycles in a national park where the majority arrive by car, and to compare the results with those from other natural spaces with different visitor mobility patterns.

The rest of the paper is organized as follows. In Section 2, the main characteristics of the TNP and the mobility patterns of its visitors are described, and a descriptive analysis of the data obtained in the RP and SP surveys is presented. In Section 3, the methodology used is explained. Then, in Section 4, the most significant results are discussed. In the final section, some of the main conclusions are presented.

2. Data

In this section, we outline the characteristics of the TNP and the mobility patterns of park visitors. We then present information from the RP survey of 801 visitors and from the SP survey of 602 visitors, both administered in July 2016. The information from the two surveys is used to estimate the discrete choice models that are described in the subsequent section.

2.1. Characteristics of the Teide National Park and Visitor Mobility Patterns

The TNP is located in the centre of the island of Tenerife (Canary Islands, Spain) and covers an area of almost 19,000 hectares at an average altitude of 2000 m. Its summit (El Teide) is the highest peak in Spain, at 3718 m. The park was created in 1954 in recognition of its unique volcanic and biological characteristics and was declared a World Heritage Site by UNESCO in 2007.

The TNP has become increasingly important as a tourist resource. It is the most visited park in the Spanish national park network; in 2016, it received 27% of the total number of visitors to the network, setting a new record of 4,079,823 visits. In addition, since 1996, it has received more than three million visitors a year and over this 20-year period has presented a growth of 36%.

The presence of visitors is concentrated in certain months and at peak times of day. The behaviour is seasonal; the maximum influx occurs in the summer months, especially in August, with 353,918 visitors in 2015, and at Easter (March or April). In June, there are fewer visitors (see Figure 1). These data reflect that, on average, the TNP receives more than 270,000 visitors per month and more than 9000 per day. In addition, the maximum number of visitors at any one time, expressed as the difference between entries and exits for each hour of the day, is 2278. The average length of stay in the park is nearly two hours, with the time of arrival concentrated mainly between 11:00 and 12:00.

The days with the highest number of visits are the weekend, especially Sundays, with an average of more than 11,000 visits. By contrast, Monday is the day with the fewest visitors, with an average of slightly below 8000 visitors compared with the daily average of 9000.

Access to the TNP is straightforward, since the park is crossed from northeast to southwest by a single road and can be reached in less than one hour from any point on the island. Four roads lead to the park (see Figure 2): two from the north and two from the south. There are also two regular public bus services that leave from two points on the island. However, they have a single departure and return time, and only allow passengers to get off at three stops. Given the high number of visitors, this supply of regular public transport is clearly deficient. If we add to this the fact that the park has 652 free parking spaces for cars distributed in 33 car parks along the road that runs through it, it is no surprise that the majority of tourists visiting the TNP choose rental cars as their main means of access, followed at some distance by tourist buses.

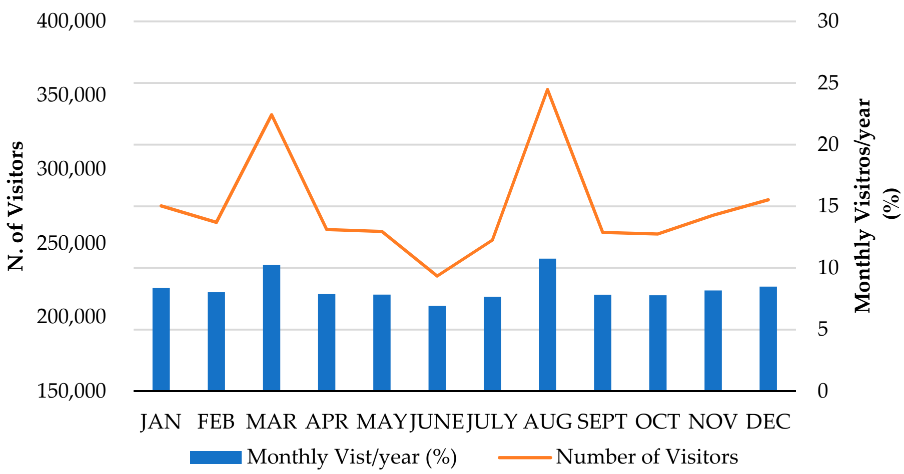

Figure 1. Monthly visitors to the Teide National Park. Year 2015. Source: TNP Authorities and prepared by authors.

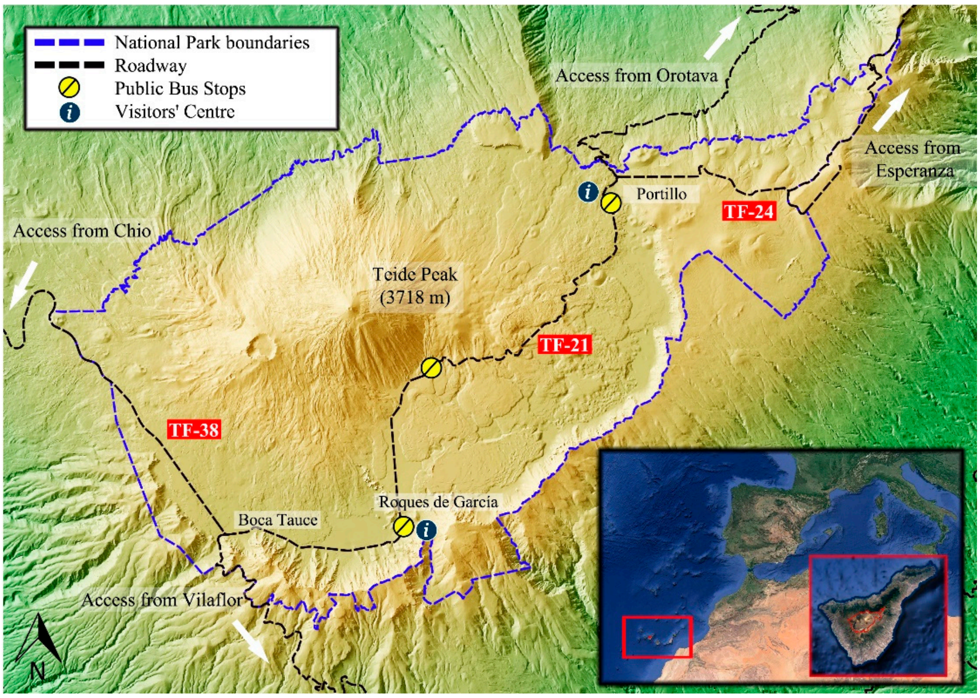

Figure 2. Teide National Park. Source: Prepared by authors.

Thus, 70% of visitors choose the car to access and move through the TNP, while almost all of the remaining 30% use discretionary transport buses (i.e., organized excursions). Table 1 shows the number of cars and buses that access the park per month and the maximum number of vehicles and any one time. Obviously, the months of maximum and minimum influx of vehicles coincide with the months of highest and lowest influx of visitors. The average number of buses accessing the park exceeds 2200, with a daily average of over 70. As for cars, the daily average is higher than 2000 for all months except June, and reaches its peak in the month of August with an average of 2720 cars per day.

Considering these figures and the capacity of the parking areas inside the park, there are clearly problems of congestion and over-occupancy. In the case of buses, the maximum number of vehicles is around 20 and the park has 19 bus parking spaces. As for cars, the park has 652 parking spaces and an average maximum number of vehicles at any one time of 669 cars; the highest level is reached in February, with 789 vehicles inside the park at any one time. These problems of saturation are aggravated in the car parks with the highest demand, such as the ones close to the cable car station (see Figure 2), leading to arguments between users and the occupation of hard shoulders and protected areas.

Table 1. Cars and buses and maximum number of vehicles in the TNP (2015).

Month	Types of Vehicle		Daily Average		Maximum No. of Vehicles	
	Cars	**Buses**	**Cars**	**Buses**	**Cars**	**Buses**
January	73,631	1981	2375	64	717	12
February	72,465	2001	2588	71	789	19
March	90,309	2625	2913	85	730	27
April	68,951	2314	2298	77	586	23
May	62,276	2174	2009	70	522	21
June	54,637	2075	1821	69	471	20
July	63,009	2162	2033	70	509	20
August	84,328	2703	2720	87	617	24
September	69,014	2051	2300	68	583	18
October	69,313	2076	2236	67	608	19
November	75,018	2350	2501	78	690	25
December	69,714	1924	2249	62	621	18
Average	**73,526**	**2219**	**2437**	**73**	**669**	**20**

Source: TNP Authorities and prepared by authors.

2.2. Revealed Preferences Survey and Data Analysis

The information used in this paper comes from two surveys (one RP and the other SP) conducted in July 2016 with 801 and 602 park visitors, respectively. Face-to-face interviews were carried out, in which the interviewer formulated the questions and helped the respondent to clarify any doubts. The surveys were conducted in English, German and Spanish at two of the most visited sites (the state-owned Parador hotel and the Teide cable car station).

To obtain the sample of respondents, we used stratified random sampling with layers comprising the nationality and mode of transport used by the visitor. The sample was stratified into four nationality categories (15% British, 15% German, 40% Spanish and 30% rest of the world) and into three mode of transport categories (70% by car, 28% by discretional tourist bus, and 2% by regular public bus).

The questionnaire included items referring to socioeconomic characteristics: sex, age, place of habitual residence, area of accommodation on the island, and reason for the stay in Tenerife. Other items were related to the visit to the TNP: the number of times respondents had visited the park, and the number of companions in their group. Next, the respondents indicated which mode of transport they had used to get to the park, choosing between five possible modes: rental car, private car, tourist bus, public bus and taxi. They were also asked to specify the reason for their choice of transport (convenience, price, fear of driving in another country, no driving licence, excursion included in the package, and other), the time of departure from the accommodation and the time of arrival at the park, the cost, whether they have considered alternative modes of transport, and the planned parking time if they travelled by car. Table 2 shows the main socioeconomic characteristics of the respondents and details of their visit to the park.

Table 2 shows an unequal distribution by sex, with a greater proportion of male visitors. This is because most of the drivers that enter the park are men. As for age, the most frequent age bracket was 31–45 years old, which represented practically 35% of the sample. Note also the high proportion of young visitors between 18 and 30 years old, who accounted for more than 36%. In relation to nationality, the information recorded reflects approximately the strata sought during the design phase of the survey.

More than 80% of the respondents were visiting the park for the first time and 45% were accompanied by one other person. The majority option for reaching the TNP was as a driver of a rental car (70% of respondents). The second most common mode of transport was the tourist bus, reported by 22%; this type of excursion is usually purchased by tourists either at origin and is included in the trip, or at the destination, offered at the hotels where they stay. Table 2 also highlights the low use of public buses which account for only 0.37% of the quota. The main reason highlighted by visitors for their choice of transport was convenience (80%), followed by price, mentioned by 10% of respondents.

Table 2. Socioeconomic characteristics of the sample.

Gender	*N*	%	*Age*	*N*	%
Women	277	34.58	18–25 years old	75	9.36
Men	524	65.42	26–30 years old	218	27.22
Number of times visited the park	*N*	%	31–45 years old	277	34.58
It is the first time	667	85.4	46–50 years old	157	19.5
Twice	78	9.99	51–60 years old	61	7.62
3 times	22	2.82	61 or over	13	1.62
4 times	5	0.64	*Reason for choice of transport*	*N*	%
More than 4 times	9	1.15	It is more convenient	644	80.40
Mode of Transport chosen	*N*	%	It is cheaper	74	9.24
Rental car as driver	563	70.29	Excursion to Teide included in package	63	7.87
Tourist bus	183	22.85	Afraid of driving in another country	7	0.87
Private car as a driver	43	5.37	No driving licence	4	0.50
Rental car as a companion	8	1.00	Don't like driving	1	0.12
Regular line bus (TITSA)	3	0.37	Don't know/None	1	0.12
Cab	1	0.12	Other	7	0.87
Number of Companions	*N*	%	*Place of residence*	*N*	%
Alone	8	1.00	Tenerife	20	2.50
2	358	44.69	Another Canary Island	23	2.87
3	134	16.73	Mainland Spain/Balearic Islands	297	37.08
4	210	26.22	Germany	145	18.10
5	51	6.37	United Kingdom	123	15.36
6	19	2.37	France	62	7.74
7	8	1.00	Italy	28	3.50
8	5	0.62	Other	83	10.36
More than 8	8	1.00	No answer	20	2.50

Source: Prepared by authors.

The only source of information available to evaluate the representativeness of the sample from a qualitative point of view is the Tourism Survey carried out by the Island Authority (Cabildo de Tenerife). This survey, conducted with tourists at the airport at the time of departure, provides information on TNP visitors' profiles. It shows that most visitors are between 31 and 45 years old, that 60% visited the park for the first time and that 58% visited with their partner—figures similar to the ones obtained in our sample.

To analyse visitors' propensity to use bicycles while travelling along the road that crosses the park, a series of questions related on the subject were included. The answers to these questions are detailed in Table 3. The first one asked whether interviewees knew how to ride a bicycle; the rate of positive answers, above 70%, shows that the bicycle could be a suitable means of transport for a high percentage of visitors. The 571 respondents who answered affirmatively were then asked about their bicycle use; 18% described their bicycle use as frequent and 28% as sporadic, while the majority (54%) stated they were not habitual cyclists. The 261 frequent or sporadic users were asked what kind of use they habitually made of their bicycle: 74% reported using bicycles for leisure and sports, while 26% used them as a mode of transport.

Table 3. Questions related to visitors' propensity to use bicycles.

Do You Know How to Ride a Bicycle?	**N**	**%**
No	230	28.71
Yes	571	71.29
Total	**801**	**100**
Are you a bicycle user?		
Yes, frequently	104	18.21
Occasionally	157	27.50
No	310	54.29
Total	**571**	**100**
Why do you frequently use a bicycle?		
For sport	144	43.90
For leisure	98	29.88
As means of transport	86	26.22
Other	0	0.00
Total *	**328**	**100**
Propensity to use a bicycle in the Teide National Park		
Probably yes	203	35.55
I'm not sure	138	24.17
I definitely wouldn't	89	15.59
Probably not	80	14.01
I definitely would	61	10.68
Total	**571**	**100**
What type of bicycle would you prefer?		
Electric	180	68.18
Conventional	51	19.32
They are all the same	33	12.50
Total	**264**	**100**
Why would you not use a bicycle to move around the Park?		
I travel with more people who would not use a bike and I do not want to break the group	139	34.07
I find it unsafe	86	21.08
I do not like to use a bike	65	15.93
There is no exclusive bike lane	32	7.84
Other	86	21.08
Total *	**408**	**100**

* The sums are superior to the total of individuals because respondents could choose several options. Source: Prepared by authors.

The 571 respondents who said they knew how to ride a bicycle were also asked if they would be willing to cycle on their visit to the TNP. To simulate this scenario, the respondents were presented with a hypothetical situation in which conventional and electric bicycles were offered to make the journey along the road that crosses the park, and in which parking places would be available for them at various points along the route. In the scenario, one of the lanes on the road was turned into a cycle lane. More than 46% said they would "definitely" or "probably" be willing to use a bicycle, compared to 29% who said "definitely not" or "probably not". A high percentage (24%) said they were not sure about using a bicycle, stating concerns about the infrastructure. The 46% who stated that they would "probably" or "definitely" use the bicycle during their visit were asked what type of bicycle they would prefer: the majority (68%) stated that they would opt for an electric bicycle, while 19% would choose a conventional bicycle.

Finally, respondents who said that they "definitely would not" or "probably would not" be willing to use the bicycle, or who would not be sure about using it, were asked to give their reasons. The most frequently reported reason (34%) was that they were travelling with other people who would not want to use the bicycle, followed by the lack of safety (21%) and the simple fact that they do not like cycling (16%). Twenty-one per cent cited “other reasons”: 59 mentioned the heat, while 12 said that they would not cycle due to the lack of time. This latter reason may be due to the fact that visitors who come to the park by tourist bus on an organized excursion have limited visiting time.

2.3. Stated Preferences Survey and Data Analysis

The 604 visitors who accessed the park by car, either as a driver or companion, were presented with an SP experiment which simulated the implementation of an internal bus crossing the TNP. Of these respondents, 218 always chose the same option in the four proposed scenarios, so they were eliminated from the sample. Therefore, the final sample consisted of 386 respondents who produced a total of 1544 observations.

Individuals were randomly selected at different points of interest throughout the park, such as El Portillo, the Parador Hotel and the Cable Car station. These sites were chosen because visitors usually stop there and stay there for long enough to devote a few minutes to completing the questionnaire. The questionnaire comprised the following blocks of items: (i) socioeconomic information about the respondent; (ii) information about the trip; (iii) intention to use sustainable modes of transport within the park; and (iv) the discrete choice experiment.

The participants in the experiment had to choose between using the car (that is, the current option) and a hypothetical bus connecting the main points of interest and the two main entrances to the park. Specifically, the experiment considers a hypothetical situation in which visitors have the option of leaving their car in a low-cost parking area located at the entrance to the park, and from there make their visit by bus. Alternatively, they could decide to continue the visit in their own vehicle.

The park bus follows a circuit, acting as a transport service that stops at the places of interest. The service is free and visitors will only have to pay for the use of the parking area. The bus could be electric or diesel, with the corresponding levels of greenhouse gas emissions. People who use this alternative will have to wait a certain amount of time to begin the visit, depending on the frequency of the service. By contrast, car users will have to spend some time finding a parking space at the different sites and will have to pay higher parking fees. The greenhouse gas emissions per car passenger are also expected to be higher than those of bus users.

For the SP experiment, an experimental design was generated consisting of 12 hypothetical scenarios of choice between the car and the bus [14]. The experiment was divided into three blocks of four scenarios each. Thus, respondents had to answer only four choice situations, depending on the block assigned to them. To preserve the efficiency of the experiment, the size of the sample was tripled, taking into account that the number of interviews for each of the blocks had to be balanced.

The answers given in the SP experiment showed that in all the blocks there was at least one scenario in which most of the respondents preferred the car alternative. In these scenarios, the cost of parking for the car is €0. Similarly, the bus option was chosen mainly in the scenarios in which its cost was €0. These results show the importance of the cost variable in the choice of transport mode.

As regards the sociodemographic profile of participants in the SP experiment, 74% of respondents were men, average age 38 years old, foreigners (53%), residents of Germany (33%), on vacation (99.7%), staying in accommodation in the tourist areas of Playa de las Américas and Puerto de la Cruz (51%), visiting the TNP for the first time (87%), travelling in a group of an average of three people, using a rental car to access the park (93%) mainly due to convenience (90%) and had not considered other transport alternatives for their trip (93%). Most of them stated that they had no problem finding space to park (82%), that they knew how to ride a bicycle (77%), although they were not regular cyclists (57%). However, they would be willing to use electric bicycles to visit the park if this mode was available (36%).

3. Methodology for the Analysis of Ordered Choices

The analysis of consumer preferences has greatly benefited from the development of discrete choice models during the second half of the 20th century. Since the formalization of the microeconomic model of discrete choices [15,16] and the random utility model [17,18] that sets the underpinnings for the specification of the different econometric models of choice, a multitude of applications have been developed in many different fields, including transportation, environmental studies, tourism, health and marketing. These models have allowed researchers and policy makers to gain a better understanding of consumers' decision-making.

Ordered models are regression models applicable to situations where the dependent variable is presented in an orderly manner in different categories; for example, the degree of preference for a given option or the level of satisfaction experienced by the consumption of a good or service. These categories are usually coded in the surveys as 0, 1, 2, 3, etcetera. In these cases, traditional models of discrete dependent variable such as the multinomial logit model [15] would not be suitable, since they do not consider the ordered nature of the dependent variable. By contrast, linear regression models treat the differences between one category and another in a similar way; for example, the difference between 2 and 3 would be treated identically to the difference between category 3 and 4, and so these models would not be suitable either.

The ordered logit model (the reader is referred to a comprehensive guide both for theoretical and implementation purposes of ordered logit models by Greene and Hensher [19]) belongs to this family of models and is based on the following latent regression:

$$Y^* = \beta' X + \varepsilon \tag{1}$$

where Y^* represents the dependent variable that is a latent variable, which is not directly observed by the researcher, and $\beta' X$ is the measurable part that is represented through a linear combination of unknown parameters and attributes or explanatory variables, and ε represents the random error, which in this case follows a logistic distribution. (Normal distribution is also commonly used. In this case, the ordered probit model is obtained. These models were introduced by Mckelvey and Zavoina [20]) The dependent variable is measured through a set of indicators so that:

$$\begin{gathered} Y = 0 \; if \; -\infty < Y^* \leq \mu_0 \quad with \quad \mu_0 = 0 \\ Y = 1 \; if \; \mu_0 < Y^* \leq \mu_1 \\ Y = 2 \; if \; \mu_1 < Y^* \leq \mu_2 \\ Y = J \; if \; \mu_{J-1} < Y^* \leq \mu_J \quad with \quad \mu_J = +\infty \end{gathered} \tag{2}$$

where μ_J are unknown parameters to be estimated that would mark the limits of each category. In this way, given the scores obtained in the explanatory variables, the probability of each category can be calculated by means of the following expressions:

$$\begin{gathered} P(Y=0) = Prob(Y^* \leq \mu_0) = Prob(\beta' X + \varepsilon \leq 0) = F(-\beta' X) \\ P(Y=j)_{j=1,\ldots,J-1} = Prob(\mu_{j-1} < Y^* \leq \mu_j) = Prob(\mu_{j-1} < \beta' X + \varepsilon \leq \mu_j) = F(\mu_j - \beta' X) - F(\mu_{j-1} - \beta' X) \\ P(Y=J) = Prob(Y^* > \mu_{j-1}) = Prob(\beta' X + \varepsilon > \mu_{j-1}) = 1 - F(\mu_{j-1} - \beta' X) \end{gathered} \tag{3}$$

with F being the probability distribution function of ε, in this case, a logistic distribution, so that $F(x) = P(\varepsilon \leq x) = \frac{1}{1+e^{-x}}$. Once the probabilities of the categories have been obtained, it is possible to analyse how they are affected by changes in the explanatory variables through the marginal effects $\frac{\partial P(Y=j)}{\partial x_k}$. In the case of ordered logit models, these are defined as:

$$\begin{gathered} \frac{\partial P(Y=0)}{\partial x_k} = -\beta_k f(-\beta' X) \\ \frac{\partial P(Y=j)}{\partial x_k}_{j=1,\ldots,J-1} = \beta_k \left[f\left(\mu_{j-1} - \beta' X\right) - f\left(\mu_j - \beta' X\right) \right] \\ \frac{\partial P(Y=J)}{\partial x_k} = \beta_k f\left(\mu_{j-1} - \beta' X\right) \end{gathered} \tag{4}$$

where β_k is the coefficient associated with variable x_k and $f(x) = \frac{e^{-x}}{(1+e^{-x})^2}$ is the probability density function of the logistic distribution. As can be seen, in categories for each extreme, marginal effects have the opposite sign. This is an intrinsic property of the model, so if this circumstance is not fulfilled the application of this model will not be ideal. The odds ratio for category *j* is defined as:

$$\Omega_j(X) = \frac{P(Y \leq j)}{P(Y > j)} = \frac{F(\mu_j - \beta' X)}{1 - F(\mu_j - \beta' X)} = e^{(\mu_j - \beta' X)}. \quad (5)$$

These ratios involve comparing the probability of being in a category less than or equal to *j* with the probability of being in a higher category. In this way, the odds ratio, calculated at the individual level, can be interpreted as the substitution pattern between first and last categories for a given individual. Since the logistic distribution has a symmetrical density function, $\Omega_j(X) > 1$ if and only if $\mu_j - \beta' X > 0$. Likewise, when interpreting the results, it is interesting to analyse how this substitution pattern changes when there are changes in the explanatory variables. To do this, it is sufficient to analyse the quotient between the odds ratio. Thus, for example, when a continuous variable x_k passes from taking the value $x_k = x_k^0$ to $x_k = x_k^1$, the quotient of the odds-ratio to analyse would be:

$$\frac{\Omega_j(X)_{x_k = x_k^0}}{\Omega_j(X)_{x_k = x_k^1}} = e^{\beta_k (x_k^1 - x_k^0)} \quad (6)$$

whereas in the case of the qualitative variable *d*, which changes from quality $r(d_r = 1)$ to quality $s(d_s = 1)$, the quotient of the odds ratio to analyse would be:

$$\frac{\Omega_j(X)_{d_r = 1}}{\Omega_j(X)_{d_s = 1}} = e^{\beta_d^s - \beta_d^r} \quad (7)$$

with β_d^s and β_d^r being the parameters associated with the corresponding dummies. In both cases, it is observed that the quotient does not depend on category *j*, which represents another restrictive property of the model.

4. Analysis of Bicycle Use Preferences

In this section we aim to identify the factors that have the greatest influence on the propensity of visitors to the TNP to use a bicycle during their visit. To do so, we propose to test the following hypotheses:

Hypotheses 1 (H1). *The choice of access mode to the Teide National Park influences visitors' propensity to use a public bicycle system for trips within the park.*

Hypotheses 2 (H2). *A stated preference regarding the use of a sustainable mode of transport within the park influences visitors' propensity to use a public bicycle system for trips within the park.*

Hypotheses 3 (H3). *The socioeconomic profile of visitors influences their propensity to use a public bicycle system for trips within the park.*

To assess these hypotheses, the following question was included in the questionnaire:

> "Suppose that the Teide National Park provided bicycles (conventional and electric) for the trip along the road that crosses the park, and that there were parking spaces for bicycles at different points along the way. Would you be willing to use one of these bicycles?"

The responses were organized into five categories that allowed the definition of the dependent variable in the model. The categories were coded in a manner consistent with the formulation of the theoretical model presented in the previous section through the following indicators: *Y = 0 "definitely not"*, *Y = 1 "probably not"*, *Y = 2 "I'm not sure"*, *Y = 3 "probably yes"* and *Y = 4 "definitely yes"*. Thus, if we represent the unobservable latent variable *"intention to use a bicycle within the park"* by Y^*, we can obtain the probability P (Y = j) of the different categories (j = 0, . . . , 4) of the intention to use a bicycle according to the socioeconomic characteristics X of the visitor, the coefficients associated with these variables β, and the threshold values μ_j that define the categories (where $\mu_0 = 0$ and $\mu_4 = +\infty$). The models have been estimated using NLogit software package [21].

To test H1, an ordered logit model is estimated using a RP database of 801 observations which was originally designed to model the choice of transport mode to access the TNP.

During the modelling process, several specifications were considered, including the socioeconomic variables that define the visitors' profiles and variables associated with the characteristics of the trip. The estimates of the model that produced the best results are shown in Table 4.

Table 4. Estimates obtained. RP database.

Variable	Coefficient	Error Est.	t-Ratio	Confidence Int.	
				Lower	Upper
Constant	4.2084	0.2938	14.32	3.6324	4.7843
Age	−0.0591	0.0067	−8.85	−0.0722	−0.0460
Germany	−0.4794	0.1813	−2.64	−0.8348	−0.1241
Italy	−1.0576	0.4261	−2.48	−1.8928	−0.2224
Not use bike	−1.8610	0.1481	−12.56	−2.1514	−1.5707
Rental car	−2.3345	1.2756	−1.83	−4.8346	0.1655
Private car	1.8317	0.3071	5.96	1.2298	2.4336
Mu (01)	0.5563	0.0538	10.34	0.4509	0.6617
Mu (02)	1.5023	0.0773	19.42	1.3507	1.6539
Mu (03)	3.6645	0.1485	24.68	3.3735	3.9555

All parameters were significant at a confidence level of 95%, except in the case of respondents coming to the park by rental car as a companion, when the parameters were significant at 90%. Visitors who access the park by private vehicle show a positive impact on the propensity to use a bicycle during their time in the park. The rest of the variables (age, residence in Germany, residence in Italy, not using a bicycle on a regular basis in the place of residence, and accessing the park by rental car) had a negative influence on the propensity. However, the sign and magnitude of the constant term suggests the existence of other unobserved factors which had a positive impact on visitors' propensity to use bicycles.

Table 5 shows the marginal effects and elasticities of the probability of each category with respect to the explanatory variables. All the marginal effects on the probability of the propensity to use a bicycle in the categories Y = 0, Y = 3 and Y = 4 were significant at a 95% level of confidence. In the Y = 0 category, all marginal effects were positive, except when the park is accessed by private vehicle. This indicates that age, being a resident in Germany, being a resident in Italy, not using a bicycle on a regular basis and accessing the park by rental car increase the probability of not using a bicycle in the park. On the other hand, we also observe that the marginal effect of these variables is negative for the categories that represent a greater intention to use a bicycle (Y = 3 and Y = 4).

In general, it is observed that P (Y = j, j = 1, . . . , 4) is inelastic with respect to most of the variables. By contrast, P (Y = 0) has elasticity values greater than 1, except for visitors residing in Germany.

Regarding the impact of the access mode on the propensity to cycle in the park, we can conclude that access by private vehicle seems to favour the use of bicycles, since the results suggest that the probability of the categories with a low propensity of use would be reduced (Y = 0, Y = 1 and Y = 2) and the probability of the categories in which it is higher would increase (Y = 3 and Y = 4), also showing elastic values in the extreme categories.

Table 5. Marginal effects and elasticities. RP database.

Variable	Marginal Effect	Elasticity	t-Ratio	Confidence Int.	
				Lower	Upper
Marginal Effect on P (Y = 0)					
Age	0.01372	2.2699	8.58	0.01058	0.01685
Germany	0.11478	0.47514	2.59	0.02785	0.20171
Italy	0.25821	1.06887	2.56	0.06074	0.45568
Not use bicycle	0.37289	1.5436	14.51	0.32253	0.42324
Rental car ac.	0.49252	2.03884	3.08	0.17933	0.80571
Private car	−0.29725	−1.23049	−9.86	−0.35635	−0.23814
Marginal Effect on P (Y = 1)					
Age	0.00106	0.43308	3.71	0.0005	0.00162
Germany	0.00376	0.03836	1.61	−0.00082	0.00833
Italy	−0.01425	−0.1455	−0.79	−0.04949	0.02099
Not use bicycle	0.05272	0.53815	7.68	0.03926	0.06617
Rental car ac.	−0.07854	−0.80178	−1.42	−0.18702	0.02993
Private car	−0.07855	−0.80186	−5.87	−0.10476	−0.05233
Marginal Effect on P (Y = 2)					
Age	−0.0029	−0.6144	−4.91	−0.00406	−0.00174
Germany	−0.02907	−0.15381	−2.21	−0.05481	−0.00334
Italy	−0.08017	−0.42416	−2.16	−0.15275	−0.00759
Not use bicycle	−0.02448	−0.1295	−1.9	−0.04971	0.00075
Rental car ac.	−0.16827	−0.89028	−2.83	−0.28473	−0.05182
Private car	−0.05089	−0.26922	−1.89	−0.10372	0.00194
Marginal Effect on P (Y = 3)					
Age	−0.00947	−1.07461	−8.25	−0.01172	−0.00722
Germany	−0.07239	−0.20554	−2.8	−0.1231	−0.02169
Italy	−0.1355	−0.38472	−3.32	−0.21547	−0.05554
Not use bicycle	−0.2901	−0.82365	−12.93	−0.33408	−0.24612
Rental car ac.	−0.20675	−0.58699	−4.86	−0.29018	−0.12331
Private car	0.26518	0.75289	12.32	0.22298	0.30737
Marginal Effect on P (Y = 4)					
Age	−0.0024	−0.80622	−7.37	−0.00304	−0.00177
Germany	−0.01707	−0.14315	−2.94	−0.02847	−0.00567
Italy	−0.02828	−0.23715	−3.87	−0.04262	−0.01394
Not use bicycle	−0.11102	−0.93105	−7.38	−0.14053	−0.08152
Rental car ac.	−0.03896	−0.32672	−5.87	−0.05198	−0.02594
Private car	0.1615	1.35437	3.29	0.06533	0.25768
Non-significant at 95%					

To determine the intention of using a bicycle, the odds ratio for each member of the different categories are calculated and the percentage of individuals for which this value is greater (and less than or equal to) than one is obtained. The results of the analysis are shown in Figure 3. Thus, for example, we observe that for 25.72% of respondents $\Omega_2 \leq 1$; that is, the probability of being in a category higher than 2 ("*would probably use the bicycle*" or "*would definitely use the bicycle*") is greater than the probability of being in a category less than or equal to 2 ("*would definitely not use the bicycle*", "*would probably not use the bicycle*" or "*I'm not sure*"). These respondents show a greater substitution pattern between the categories of high propensity of use versus those of low propensity (the probability of the denominator is greater). The results for the rest of the categories could be interpreted in the same way.

Table 6 shows the quotients among the odds ratios to analyse how the substitution pattern varies between categories of low and high propensity of use. We observe that, at older ages, the substitution pattern between categories of low propensity of use increases in comparison with those of high propensity. The same is true for residents of Germany, residents of Italy, respondents who do not use a bicycle regularly and those who access the park by rental car as companions. However, for visitors who access the park by private vehicle, this substitution pattern decreases.

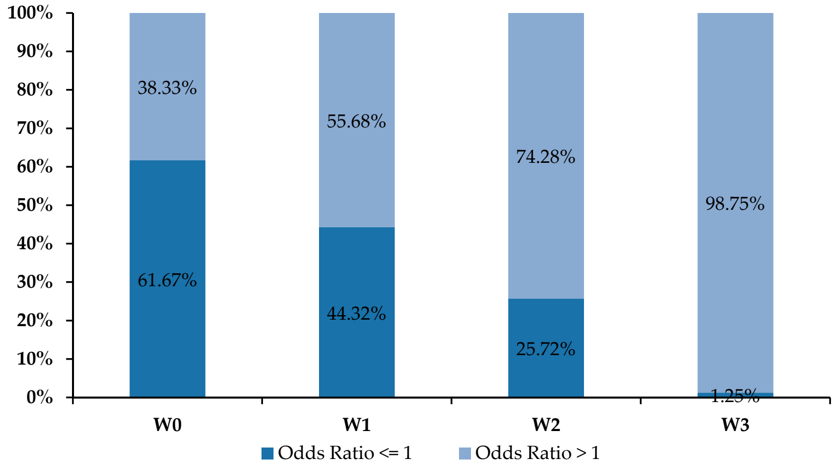

Figure 3. Odds ratio. RP database.

Table 6. Quotient of odds ratio. RP database.

Variable	Quotients of Odds-Ratio
Age	0.94
Germany	0.62
Italy	0.35
Not use bicycle	0.16
Rental car ac.	0.10
Private car	6.24

To test H2, an ordered logit model is estimated with a SP database that was designed to analyse the preferences of visitors regarding the use of sustainable means of transport during their visit to the park. Specifically, the different scenarios of the experiment posed the choice between the car (the current alternative) and a low environmental impact bus stopping at the park's points of interest.

Table 7 shows the results of the estimates. All variables considered were significant at a confidence level of 95%. In this case, we observe that respondents who stated that they would use the bus to visit the park and those who reside in Tenerife have a positive impact on the intention of using a bicycle inside the park. In contrast, age, residence in Germany, the UK or Italy and not using a bicycle on a regular basis at home had a negative impact. As in the previous case, there are also unobserved positive impacts.

In general, our results are consistent with previous reports of the impact of environmental values and beliefs on pro-environmental behaviours such as using public transportation for commuting [22] or using alternative transports [23]. Moreover, our age-related results are consistent with those obtained by Moscardo et al. [24], who found differences in activity preferences between older and younger individuals (older visitors tend to participate in sightseeing and interpretive activities, while younger visitors tend to participate in recreational activities such as hiking, mountain biking and camping). Studies addressing visitors' attitudes towards alternative transportation systems in national parks have found that older visitors are less likely to use them [9,24]. These differences in activity preferences between younger and older individuals could explain the influence of visitors' age on the willingness to use bicycles in the TNP.

Several studies of bicycle commuting in urban environments have found results consistent with ours, indicating effects of age, gender and nationality on the propensity to use a bicycle (see among others: [25–27].

Table 7. Estimates obtained. SP database.

Variable	Coefficient	Error Est.	t-Ratio	Confidence Int.	
				Lower	Upper
Constant	4.0877	0.1794	22.79	3.7361	4.4392
Age	−0.0564	0.0040	−14.17	−0.0642	−0.0486
Tenerife	1.7429	0.2409	7.23	1.2706	2.2151
Germany	−0.4758	0.1056	−4.51	−0.6827	−0.2690
United Kingdom	0.5492	0.1235	−4.45	−0.7913	−0.3072
Italy	−0.8744	0.2257	−3.87	−1.3168	−0.4319
Not use bicycle	−1.7806	0.0848	−20.99	−1.9469	−1.6143
Would use the park bus	0.2827	0.0781	3.62	0.1297	0.4357
Mu (01)	0.5263	0.0302	17.40	0.4670	0.5856
Mu (02)	1.5458	0.0448	34.54	1.4581	1.6335
Mu (03)	3.8245	0.0872	43.84	3.6536	3.9955

Table 8 shows the marginal effects and elasticities obtained for this model. In most cases, the effects were statistically significant. The results show that residents in Tenerife and respondents who stated that they would use the bus in the park have a negative marginal effect on the categories of low propensity to use a bicycle and a positive effect on the categories of high propensity. The rest of the explanatory variables showed the opposite effect: that is, a positive marginal effect on the categories of low propensity of use, and a negative effect on those of high propensity.

The probability of the categories gave inelastic values with respect to most of the variables, with the exception of age and not using the bicycle on a regular basis in the categories Y = 0, Y = 3 and Y = 4; and being a resident of Tenerife in the categories Y = 3 and Y = 4.

The results suggest that the visitors who stated a preference for a sustainable mobility system inside the park show a greater propensity to use public bicycles. The results of both models and the analyses carried out show that visitors' socioeconomic profiles influence their propensity to use a bicycle to visit the park, thus confirming our third hypothesis (H3). Age, the lack of regular bicycle use and place of residence (Germany, Italy or the UK) are factors that reduce propensity to use this means of transport when visiting the TNP. However, the high positive propensity towards bicycles shown by residents in Tenerife is an interesting finding.

The analysis of the odds ratio is shown in Figure 4. The results are quite similar to those obtained in the analysis of the RP database: thus, in the second category, we observe that for 27.61% of the individuals $\Omega_2 \leq 1$, showing a greater substitution pattern among the categories of high intention of use than in those of low intention. The results obtained in the rest of the categories could be interpreted in a similar way.

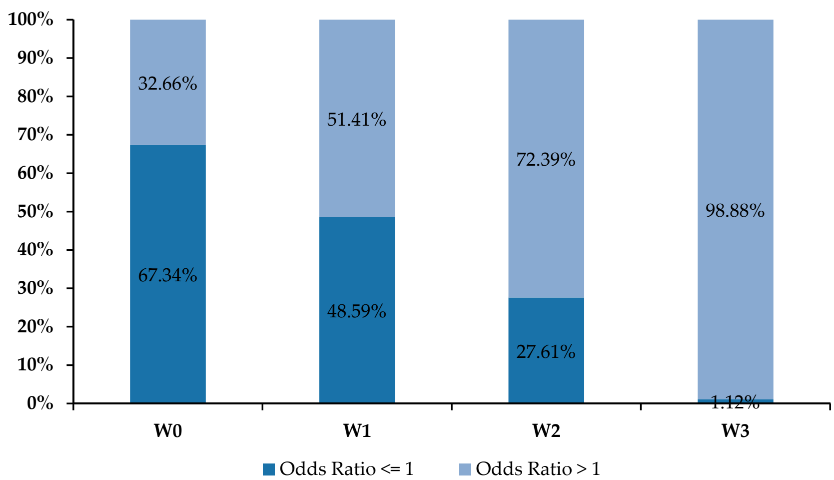

Figure 4. Odds ratio. SP database.

Table 8. Marginal effects and elasticities. SP database.

Variable	Marginal Effect	Elasticities	t-Ratio	Confidence Int.	
				Lower	Upper
		Marginal Effect on P (Y = 0)			
Age	0.0126	1.4896	13.74	0.0108	0.0144
Tenerife	−0.2622	−0.7825	−12.76	−0.3025	−0.2219
Germany	0.1105	0.3296	4.36	0.0609	0.1601
United Kingdom	0.1290	0.3850	4.28	0.0699	0.1881
Italy	0.2111	0.6300	3.78	0.1016	0.3207
Not use bicycle	0.3453	1.0304	23.64	0.3167	0.3739
Would use the park bus	−0.0629	−0.1875	−3.63	−0.0968	−0.0289
		Marginal Effect on P (Y = 1)			
Age	0.0015	0.4635	9.26	0.0012	0.0018
Tenerife	−0.0756	−0.6064	−7.96	−0.0942	−0.0570
Germany	0.0079	0.0636	5.72	0.0052	0.0107
United Kingdom	0.0074	0.0592	5.38	0.0047	0.0101
Italy	0.0010	0.0082	0.18	−0.0103	0.0124
Not use bicycle	0.0560	0.4490	15.93	0.0491	0.0629
Would use the park bus	−0.0073	−0.0581	−3.49	−0.0113	−0.0032
		Marginal Effect on P (Y = 2)			
Age	−0.0022	−0.3647	−6.72	−0.0029	−0.0016
Tenerife	−0.0721	−0.2986	−3.19	−0.1165	−0.0278
Germany	−0.0255	−0.1057	−3.51	−0.0398	−0.0113
United Kingdom	−0.0319	−0.1320	−3.4	−0.0503	−0.0135
Italy	−0.0621	−0.2571	−3	−0.1027	−0.0215
Not use bicycle	−0.0108	−0.0445	−1.4	−0.0258	0.0043
Would use the park bus	0.0110	0.0456	3.33	0.0045	0.0175
		Marginal Effect on P (Y = 3)			
Age	−0.0096	−1.4780	−13.45	−0.0109	−0.0082
Tenerife	0.2595	1.0109	16.74	0.2291	0.2899
Germany	−0.0763	−0.2971	−4.76	−0.1077	−0.0449
United Kingdom	−0.0862	−0.3359	−4.82	−0.1213	−0.0512
Italy	−0.1255	−0.4889	−4.79	−0.1769	−0.0742
Not use bicycle	−0.2905	−1.1317	−21.95	−0.3165	−0.2646
Would use the park bus	0.0478	0.1860	3.62	0.0219	0.0737
		Marginal Effect on P (Y = 4)			
Age	−0.0023	−2.1291	−12.17	−0.0026	−0.0019
Tenerife	0.1504	3.5800	4.04	0.0774	0.2233
Germany	−0.0166	−0.3947	−5.01	−0.0231	−0.0101
United Kingdom	−0.0183	−0.4349	−5.22	−0.0251	−0.0114
Italy	−0.0246	−0.5844	−5.59	−0.0332	−0.0160
Not use bicycle	−0.1000	−2.3802	−12.79	−0.1153	−0.0847
Would use the park bus	0.0113	0.2692	3.55	0.0051	0.0176
Non-significant at 95%					

The quotients between the odds ratios are shown in Table 9. We observe that at older ages the substitution pattern between low-and-high propensity-use categories increases. The same occurs for residents of Germany, the UK and Italy, as well as respondents who do not regularly use bicycles. However, for the residents of Tenerife and those who stated that they would use a bicycle in the park, the substitution pattern decreases.

Table 9. Quotient of odds ratio. SP database.

Variables	Quotient of Odds-Ratio
Age	0.95
Tenerife	5.71
Germany	0.62
United Kingdom	0.58
Italy	0.42
Not use bicycle	0.17
Would use the park bus	1.33

5. Conclusions

Empirical studies of visitor preferences with regard to bike-sharing in natural and protected areas are very scarce. The results of the present study may highlight a number of aspects that park managers need to consider if they plan to implement this service.

Our findings suggest that there is a potential demand for bicycles in the TNP, although certain socioeconomic aspects of visitors negatively influence their propensity to cycle: older age, lack of regular bicycle use and residence in Germany, Italy or the UK. Visitors with the greatest propensity to use bicycles are those who access the park by their own private vehicle, who are mostly residents of Tenerife, along with those who state that they would use an internal bus, if available. This empirical evidence provides useful information for the design of mobility management measures that would help increase visit quality and reduce the negative externalities associated with the current mobility patterns in the TNP.

Our results show that making bicycles available to visitors would encourage cycling. In this scenario, bicycle mobility could be packaged as an additional tourist attraction, and could help to make visits to national parks a sustainable tourism activity that allows more direct contact with the natural heritage. To encourage park visitors to cycle, measures should be implemented to create bike lanes (either segregated or non-segregated) or hard shoulders wide enough to allow traffic, reduce traffic speed, build bicycle infrastructures (car parks, rest areas, etc.) and provide first aid services in case of accident. Moreover, park authorities should offer "carrot and stick" incentives for sustainable travel modes other than cars. This could be done by charging for private vehicle parking inside the park, or by closing off existing roadways and offering visitors the option of leaving their cars in a low-cost parking lot at the park entrance and then touring the park by bicycle.

Author Contributions: R.M. and C.R. proposed the idea and wrote the paper; R.M and C.R. constructed the models; C.R. conducted the statistical analysis; R.M. and A.S. dealt with literature review, data description and formatting. All authors discussed the research, cooperated with each other to revise the paper, and have read and approved the final manuscript.

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