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Assessing the Impact of COVID-19 on Bike-Sharing Usage: The Case of Thessaloniki, Greece

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Abstract: The COVID-19 pandemic had a significant effect in urban mobility, while essential changes are being observed in travelers' behavior. Travelers in many cases shifted to other transport modes, especially walking and cycling, for minimizing the risk of infection. This study attempts to investigate the impact that COVID-19 had on travelers' perceptions towards bike-sharing systems and whether the pandemic could result in a greater or lesser share of trips that are being conducted through shared bikes. For that reason, a questionnaire survey was carried out in the city of Thessaloniki, Greece, and the responses of 223 people were analyzed statistically. The results of the analysis show that COVID-19 will not affect significantly the number of people using bike-sharing for their trips. However, for a proportion of people, bike-sharing is now more attractive. Moreover, the results indicate that bike-sharing is now more likely to become a more preferable mobility option for people who were previously commuting with private cars as passengers (not as drivers) and people who were already registered users in a bike-sharing system. The results also provide evidence about the importance of safety towards COVID-19 for engaging more users in bike-sharing, in order to provide them with a safe mobility option and contribute to the city's resilience and sustainability.

Keywords: urban mobility; bike-sharing; COVID-19; pandemic; resilience; modal shift

1. Introduction

COVID-19 was first identified in Wuhan, Hubei, China, and on March 11, the World Health Organization (WHO) assessed and announced that COVID-19 can be characterized as a pandemic. By the end of July, more than 14,500,000 cases and 600,000 deaths due to COVID-19 had been reported to WHO, most of them in America and Europe [1]. Already from the first months of the pandemic, most countries set restrictions in people's movements, by applying forms of lockdown, aiming to delay the pandemic peak and flatten the curve. Several studies proved that these travel restrictions managed to slow the spread of the virus globally [2–4].

Obviously, the various forms of lockdown had an essential impact on the whole transport sector worldwide (see, for instance, reference [5] for the impact on logistics and reference [6] for the impact on air transport) and consequently on the environment and energy savings where side benefits were observed [7–9], as well as on economic and social activities [10,11]. The impact of COVID-19 was also intense in the field of urban mobility. Using mobility data from various sources, the study of Aloi et al. identified a fall of 76% in the overall mobility and a fall of 93% in public transport usage in the city of Santander, Spain [12]. On the contrary, the drop of private car usage was not so significant, at least in comparison with public transport [12]. Based on longitudinal data, de Haas et al. found an 80% reduction in outdoor activities, a 55% drop in the number of trips, and a 68% drop in the distance travelled in the Netherlands [13]. Studies conducted in the United States of America identified a significant reduction in traffic volumes, reaching 80% in specific counties [14], but also a 37% decrease in driving days per week and a 35% decrease in vehicle miles driven [15]. The abovementioned significant impacts of COVID-19 on urban mobility are also proven by the Google Community Mobility Reports, which, based on mobile phone location data, found important trip reductions in almost all countries [16].

Except for the impermanent changes in urban mobility during lockdowns, COVID-19 also motivated changes in transport policy and practice that seem to have become permanent [17–19]. Many megacities, but also medium-sized cities, across the world reallocated public space in favor of cycling and walking, set restrictions on vehicle traffic, and they even gave financial support to citizens for purchasing bikes. This shift to active modes was also triggered by the advice that WHO gave through its information sheets, for travelling with a bicycle or on foot whenever feasible [20]. This tendency caused by COVID-19 is anticipated to have a permanent impact on travelers' perception and behavior. Many researchers [10,21,22] estimate that the pandemic will lead to a long-term avoidance of public transport usage, an increase in bicycling and walking, as well as a reduction in total trips due to increased levels of teleworking. These estimations are also supported by studies that have been already published. A study that was carried out in the Netherland points out that people are now more positive towards cars and very negative towards public transport [13]. The same study mentions that a large proportion of those working during the pandemic from home expect to do so more often in the future [13]. Another study which used data from Budapest, Hungary, identified an 80% public transport demand reduction, but only a 23% bicycling reduction and a 2% bike-sharing reduction [23]. The decrease in bike-sharing usage was greater in the case of Beijing, China, since 40% fewer rentals were made comparing with the same period in 2019 [24].

Bike-sharing systems have already been proven efficient in cases of disruptive events, such as public transport strikes [25], thus contributing to urban transport systems' resilience. Bike-sharing was also found to be more resilient compared to a subway system in New York City, during the COVID-19 crisis, since it had less-significant ridership reduction [26].

Despite the fact that there are already studies investigating the impact of COVID-19 on travelers' attitudes regarding private cars, public transport, bicycles and walking, the impact on sharing mobility systems has not yet been investigated. Particularly the impact on bike-sharing is of great interest, since many efforts have been made after the appearance of the pandemic for the promotion of cycling; however, it is not clear if bike-sharing is now a more- or less-attractive mobility option.

Consequently, the present paper aims to investigate the view of people about bike-sharing after COVID-19 and whether they have been motivated to use these systems more often or not. More specifically, the paper aims to shed light on whether bike-sharing is considered safer comparing with "competitive" modes of transport, whether people think that bike-sharing systems' operators take all necessary safety measures, and most importantly, who are those individuals who have more possibilities to be affected by the pandemic and shift to the bike-sharing usage. To provide an answer to the above, a questionnaire survey was designed and implemented in the city of Thessaloniki, Greece, and the collected data were analyzed through descriptive statistics, principal component analysis, and statistical modelling techniques (see Figure 1 for the overall methodology).

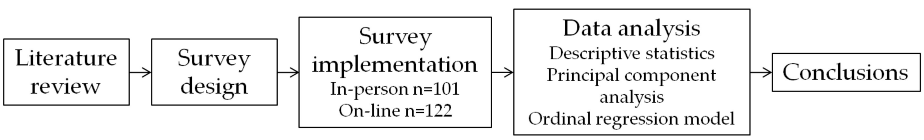

Figure 1. Overall methodology of the present study.

2. Materials and Methods

2.1. Study Area

Thessaloniki is the second-largest city in Greece. It is located in northern Greece, and it is the capital of the Region of Central Macedonia. It has a population of around 1,000,000 people in a metropolitan level and over 800,000 people in an urban level [27]. Thessaloniki's counts a large number of university students, and it is an important transport and economic node for the wider area of northern Greece.

All these years, the transport practice in the city of Thessaloniki has been to a large extent car-oriented. The bicycle volumes are very low [28] and the cycling infrastructure in the city is considered insufficient [29]. Within the city of Thessaloniki, a dock-based bike-sharing system has operated since September 2013, while recently some dockless shared bikes have been distributed in the city center. The dock-based system, which is the most known among the city's residents, operates with 200 bicycles and 8 stations (see Figure 2). During its lifetime, this system has served close to 100,000 rentals and over 16,000 subscribers. Based on previous analyses that have been conducted, it has been identified that the specific bike-sharing system is mainly used for recreational purposes and rarely for commuting [30–32]. Moreover, as can be understood by the total number of rentals, the bike-sharing system has not managed to become popular among the citizens. A similar attitude towards bike-sharing usage has been also identified in other Greek cities, and it is attributed to the lack of cycling infrastructure and road safety issues [33,34]. The limited networks of bike-sharing stations and the underutilization of technology are two additional reasons for not succeeding in attracting a high number of users [35,36].

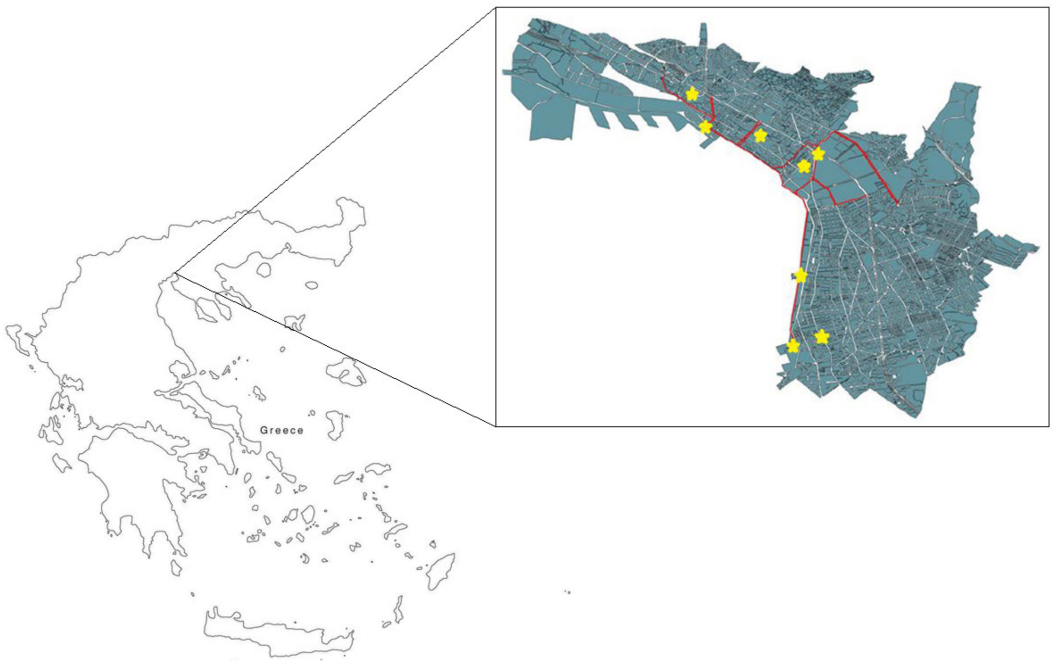

Figure 2. Bicycle lane network and bike-sharing stations in the city of Thessaloniki.

The low rates of COVID-19 cases and deaths in Greece are attributed to the timely imposition of movement restrictions. In Thessaloniki, these restrictions resulted in a traffic volume decrease that reached a 70% rate and a trip duration decrease that reached a 52% rate [37]. As in many cities worldwide, the local authorities in Thessaloniki, in an attempt to offer safe mobility options to the residents in the post-COVID-19 era, implemented some bicycle- and walking-friendly solutions. The solutions include the development of additional kilometers of bicycle lanes, the widening of sidewalks, and the implementation of shared space schemes. Thus, a great tendency is being observed in the city to promote active modes of transport both for reasons of mobility and resilience.

2.2. Data Collection

For research purposes, a comprehensive questionnaire that includes four parts was designed. The four parts are the following:

- Respondents' socioeconomic characteristics: it contains questions regarding gender, age, place of residence, occupation, education, household monthly income;
- Respondents' mobility profile: it contains questions for exercise frequency, ownership of private car and bicycle, subscription in e-scooter and bike-sharing systems before the pandemic, most frequently used transport mode before the pandemic, private car usage frequency before the pandemic;
- Attitude towards COVID-19: it contains five-point Likert [38] scale questions regarding the risk level of being infected by the virus, the usage of protective measures during trips, the respondent's perceived level of vulnerability, the intention of the respondent to avoid crowded places, the intention of the respondent to avoid using objects that have been previously used by others;
- Attitude towards bike-sharing in the post-COVID-19 era: it contains five-point Likert [38] scale questions about respondents': (a) perceived risk of infection while using bike-sharing services in comparison with other transport modes (i.e., private car, public transport, taxi, walking), (b) opinion concerning aspects of bike-sharing safety (e.g., disinfection of vehicles by operators), (c) willingness to use less- or more-frequent bike-sharing services in the post-COVID-19 era.

The questionnaire was developed both in electronic and printed forms. The electronic version was disseminated through local websites and social media, while the printed version was distributed at local events, as well as in the stations of Thessaloniki's bike-sharing system. The survey lasted one month, from 24 June 2020 to 24 July 2020. In total, 223 valid responses were gathered (122 respondents completed the electronic form and 101 the printed form); thus, for a significance level (a) equal to 5%, the margin of error (ε) is equal to 6.56% [39].

3. Results

3.1. Descriptive Analysis

The sample consists of 52.9% males and 47.1% females. Most of the respondents (52%) are aged between 25 and 39 years old, and there are also many respondents belonging in the age groups "18–24" and "40–54". The participation of people aged over 54 in the sample is weak. The 56.1% of the respondents are living in the eastern part of the city, and the 23.8% are living in the city center; the bike-sharing stations are located in these two areas. There are also 11.2% who live in the western part of the city and 9% who live in the suburbs. Regarding occupation, the highest percentages can be observed for private employees (35.4%), freelancers (24.2%), and students (20.2%). The distribution of the education level is left skewed, since the respondents, in their majority, have a high level of education. Concerning the monthly household income, there is a sufficient representation in the sample from all income classes, with over 2000 €/year and 801–1200 €/year being the most popular answers, with 26% and 24.2% correspondingly.

The majority of the respondents (63.7%) own a private car, while the sample is approximately equally distributed between those who own a bicycle or not. Of the sample, 19.3% were subscribers in the e-scooter sharing services of the city before the pandemic, and the corresponding percentage for bike-sharing services is 12.1%. The 50.5% were more frequently traveling with private cars (either as drivers or passengers) before the appearance of COVID-19, while also many of the respondents were most frequently traveling through public transport (24.3%) or by bicycle (12.2%). The reported frequency of using a private car before the pandemic is very high, since 48.9% of them were using it daily and 74.4% more than once per week.

The attitude of the respondents towards the COVID-19 pandemic is described in Table 1. It can be understood that most people believe that the risk of COVID-19 transmission within society is still high. Most people do not use protective measures while travelling, but there is also a large proportion of people who tend to use equipment, such as gloves and masks. The vast majority of the sample does not identify themselves as vulnerable to the virus, and this is probably linked to the fact that the presence of older people in the sample is limited. Also, it can be seen that more people avoid using items that have been previously used by others than being in the same place with other people, and this is maybe a disadvantage for bike-sharing systems and all sharing mobility options in general.

Table 1. Attitude towards COVID-19 pandemic.

	Do Not Agree at All	Probably Disagree	Neutral	Probably Agree	Absolutely Agree
The probability of transmission of COVID-19 is high.	5.8%	14.8%	25.6%	29.1%	24.7%
I always wear protective equipment during trips.	22.1%	27.9%	27%	10.4%	12.6%
I belong to a vulnerable group of people.	75.7%	11.7%	6.8%	3.6%	2.3%
I avoid being in the same place with other people.	26.9%	23.8%	30.5%	13.5%	5.4%
I avoid using items that have been previously used by others.	12.1%	18.8%	23.3%	26.5%	19.3%

The safety, towards the transmission of the virus, of bike-sharing systems in comparison with other transport modes is presented in Figure 3. It can be seen that private cars and especially walking are believed to be safer than using a shared bike. On the other hand, bike-sharing is considered safer than travelling in a taxi and much safer than using public transport, which, particularly in the city of Thessaloniki, is in many cases overcrowded.

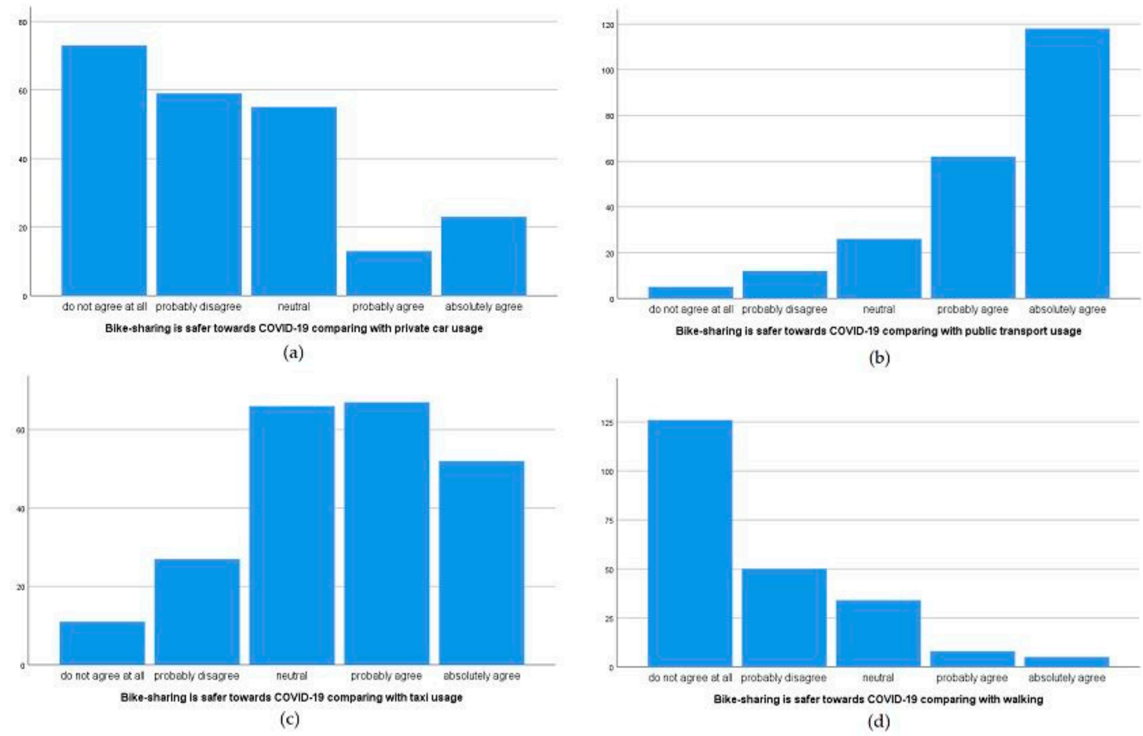

Figure 3. Perceived safety towards COVID-19 of using bike-sharing in comparison with other transport modes: (**a**) private car; (**b**) public transport; (**c**) taxi; (**d**) walking.

Table 2 presents respondents' views regarding the safety of bike-sharing, towards the transmission of COVID-19, in the various phases of the rental process. Most of the respondents have no clear opinion on whether operators apply precautionary measures (e.g., disinfection), but a negative tendency in the replies can be observed. On the other hand, there is a positive tendency in people's responses concerning the reduction of the risk of infection due to the fact that bikes are mostly rented through mobile applications (however, there are still cases where users prefer to rent their bike from stations where there is a company's staff available for supporting the rental process). Respondents' opinions are divided about whether the existing infrastructure in the city is giving bike-sharing users (and bicycle users in general) the opportunity to ride in comfort and respecting social distancing.

Table 2. Opinion regarding safety of bike-sharing, towards COVID-19, in different phases of the rental process.

	Do Not Agree at All	Probably Disagree	Neutral	Probably Agree	Absolutely Agree
Bike-sharing operators take the necessary precautionary measures (e.g., bike disinfection).	10.9%	23.1%	48%	10.9%	7.2%
The rental process does not require contact with an employee, and therefore the possibility of infection is significantly reduced.	9%	22.9%	27.4%	26.5%	14.3%
When traveling by shared bike, I have the opportunity to use comfortable infrastructure, which is not crowded.	12.6%	15.7%	32.3%	22.4%	17%

The impact of COVID-19 on bike-sharing usage, i.e., on people's intention to use less- or more-frequent bike-sharing services in the post-COVID-19 era, is presented in Figure 4. It seems that most people have not modified their attitude after the pandemic, and thus their intention of using or avoiding bike-sharing has not changed. People who in the pre-COVID-19 period were already using active modes as their main mode of transport are the only group of travelers among whom the positive attitude outmatches the negative one. On the other hand, the percentage of people who were previously using mainly private cars or public transport and are now thinking of shifting to bike-sharing is low, and it is lower compared to the percentage of people who formed a more negative attitude towards bike-sharing usage.

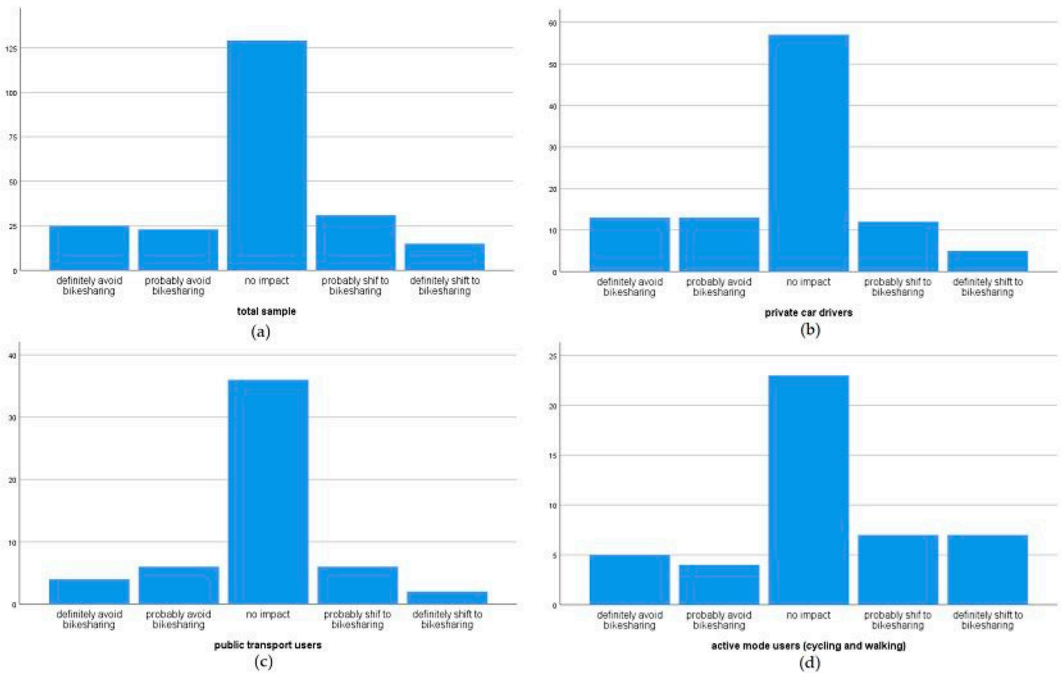

Figure 4. Impact of COVID-19 on bike-sharing usage: (**a**) for the total sample; (**b**) for private car drivers; (**c**) for public transport users; (**d**) active mode users.

3.2. Principal Component Analysis

In order to reduce the complexity of the ordinal regression model, that is the next step of the analysis and is presented in the following section, the Principal Component Analysis (PCA) was performed.

More specifically, the aim of the PCA in this paper was to create a small number of new variables that describe multidimensional data, which were gathered directly by the questionnaire survey.

As has been already described, the questionnaire was designed in a way that is capable of capturing people's attitudes towards COVID-19 and attitudes towards bike-sharing safety in the post-COVID-19 era, through several questions. Thus, two different PCAs were carried out. In the first PCA, the questions aiming to identify what people are thinking about the pandemic and how they behave in this time (the full set of these questions can be found in the first column of Table 3) were analyzed. In the second PCA, the questions concerning bike-sharing safety were analyzed (the full set of these questions can be found in the first column of Table 4).

Table 3. Rotated component matrix for questions dealing with people's attitudes towards COVID-19.

	Component 1	**Component 2**
The probability of transmission of COVID-19 is high.	0.828	−0.120
I avoid using items that have been previously used by others.	0.794	−0.003
I avoid being in the same place with other people.	0.754	0.209
I always wear protective equipment during trips.	0.691	−0.018
I belong to a vulnerable group of people.	0.002	0.986

Table 4. Rotated component matrix for questions dealing with people's attitudes towards bike-sharing safety.

	Component 1	**Component 2**
Bike-sharing safety comparing to taxi usage	0.759	0.122
Bike-sharing safety comparing to walking	0.731	−0.164
Bike-sharing safety comparing to private car usage	0.715	−0.003
Bike-sharing safety comparing to public transport usage	0.625	0.222
When traveling by shared bike, I have the opportunity to use comfortable infrastructure, which is not crowded.	−0.007	0.800
Bike-sharing operators take the necessary precautionary measures (e.g., bikes disinfection).	−0.085	0.783
The rental process does not require contact with an employee and therefore the possibility of infection is significantly reduced.	0.195	0.700

As a first step of the analysis, the selection of the number of components to extract was made. Based on the scree plot and the eigenvalues, for the first group of variables (first PCA), the extraction of two components is considered appropriate. The eigenvalue of the first component is 2.45, and the eigenvalue of the second component is 0.961, which is slightly lower than 1 (eigenvalues greater than 1 are usually being sought). Then, the analysis is being conducted again with a fixed number of factors, equal to two. The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) is 0.751 (values greater than 0.6 are considered adequate) and the Bartlett's test of sphericity shows that the variables are related ($p < 0.05$). According to the aforementioned tests, the data are suitable for detecting structures/components. The total amount of variance accounted for in the construct by the two components is equal to 68.2%; 48.99% from the first component and 19.21% from the second one. Table 3 presents the rotated component matrix, as it was computed based on the Direct oblimin rotation method. The results clearly indicate that there is a set of 4 original variables expressing the one component and another original variable expressing the second component. In this way, the original 5 variables form 2 new variables (components), namely: (a) taking precautionary measures against COVID-19, (b) vulnerability.

The same procedure was followed for the set of questions that deal with attitudes towards bike-sharing safety in the post-COVID-19 era (second PCA). In the case of this set of variables, the extraction of two components is also considered appropriate. The first component eigenvalue is

2.771 and the eigenvalue of the second component is 1.227. The analysis is being conducted again, by setting two fixed factors. The KMO is equal to 0.733, and the Bartlett's test of sphericity shows that the variables are related ($p < 0.05$), thus, indicating that the data are appropriate for structures detection. The two components explain the 57.11% of the construct variance; 39.58% is explained by the first structure and 17.53% by the second one. The rotated component matrix, as it was computed with the Direct oblimin rotation method, is presented in Table 4. Based on the presented values, it is concluded that the original 7 variables can be reduced to 2, namely: (a) bike-sharing safety comparing to alternatives, (b) safety provided by bike-sharing.

Therefore, through the two PCAs that were conducted, the 12 original variables of the questionnaire formed the following 4 new variables (components):

- taking_precautionary_measures;
- vulnerability;
- safety_comparing_to_alternatives;
- safety_provided;

Thus, for the next step of the analysis (i.e., ordinal regression model), the 4 new variables are being examined instead of the 12 original variables.

3.3. Ordinal Regression Model

The aim of the ordinal regression analysis, in this paper, is to identify factors that have a significant impact on people's intentions to use or to avoid bike-sharing systems in the post-COVID-19 era, as well as to quantify this impact. The specific type of analysis was considered appropriate, and it was selected due to the ordinal nature of the dependent variable. Due to the fact that the distribution of the responses on the dependent variable is extremely unequal to the different classes (as it is shown in Figure 2), but also for providing more meaningful results, the dependent variable was re-coded as presented in Table 5. It should be noted that the analysis was carried out in the R programming language [40].

Table 5. Re-coding of the dependent variable.

Initial Coding	Final Coding
Definitely avoid bike-sharing due to COVID-19 Probably avoid bike-sharing due to COVID-19	Avoid bike-sharing due to COVID-19
No impact	No impact
Probably shift to bike-sharing due to COVID-19 Definitely shift to bike-sharing due to COVID-19	Shift to bike-sharing due to COVID-19

Respondents' socioeconomic and mobility characteristics, as well as the 4 components that were structured through the PCA, were examined as potential independent variables in the model. The minimization of the Akaike information criterion (AIC) was used as a main criterion for the model selection, while trying to make the final model contain only statistically significant variables. The AIC is an estimator of the model's quality, that makes a trade-off between the goodness of fit and the simplicity of the model [41]. After many trial-and-error tests, the variables that were finally included in the model are presented in Table 6, along with their coefficient, standard error, *t*-value, *p*-value and the computed (by exponentiating the coefficients) odds ratios. In this trial-and-error tests, a full model (containing all potential independent variables) was firstly developed, and in each step till the development of the final model, the variable with the highest *p*-value and the greatest negative impact in the AIC was eliminated. All the variables that were finally included in the model and are presented in Table 6 are statistically significant at a significance level equal to 5%. It should be noted that the "bikesharing_subscriber" and the "safety_provided" were the two variables that were statistically significant predictors in all the examined models; thus, they can be considered as the most important variables in predicting people's intention to shift or avoid bike-sharing in the post-COVID-19 era.

Table 6. Model parameter estimates and odds ratios.

	Estimate	Std. Error	*t*-Value	*p*-Value	Odds Ratios
bikesharing_subscriber: no	−1.242	0.456	−2.726	0.006	0.289
most_used_mode: private car as a passenger	1.241	0.618	2.010	0.044	3.459
safety_comparing_to_alternatives	0.447	0.152	2.947	0.003	1.564
safety_provided	0.542	0.152	3.571	0.001	1.719
AIC = 403.626; McFadden's Pseudo-R^2 = 12.1%					

From Table 6, it can be concluded that the two components that were derived from the second PCA and concern the safety of bike-sharing towards COVID-19 have a significant role to play in people's intention to shift or avoid using shared bikes. It should be mentioned that the strong significance of the two constructed components does not imply that all the individual variables that formed these components would be necessarily statistically significant in the specific model. On the other hand, the two components that were derived from the first PCA (i.e., taking_precautionary_measures and vulnerability) were not found to be statistically significant predictors. Also, from Table 6 it can be understood that people who before the pandemic were most frequently traveling with private car as passengers are much more likely than those who were previously commuting with private car as drivers (which is the reference category) to shift to bike-sharing due to COVID-19. Finally, people who before the pandemic were already registered users in a bike-sharing system are more likely to shift to bike-sharing due to COVID-19.

4. Discussion

The present paper investigated people's perceptions towards bike-sharing systems after the appearance of the COVID-19 pandemic and the attractiveness of these systems in this new era. The descriptive analysis shows that people share the opinion that bike-sharing is not as safe as walking or using a private car, but it can be a safer option compared to using a taxi and especially compared to public transport usage. Many of the respondents have doubts about whether operators are disinfecting the vehicles regularly and whether it is easy to use the system without having any contact with the staff of the system, which could potentially increase the risk of cross-contamination. Moreover, based on the descriptive statistics, it seems that there are also doubts concerning whether the existing bicycle infrastructure in the city are sufficient for avoiding overcrowd and preserving a safe distance from other travelers.

Most respondents stated that COVID-19 will not affect their intention to use bike-sharing systems, probably indicating that, in societies that rely heavily on private cars, which are considered to provide higher levels of hygiene, bike-sharing will not manage to attract many new users. However, there are people who have been affected positively (i.e., it is now more likely to use bike-sharing) and others who have been affected negatively (i.e., it is now less likely to use bike-sharing). Based on the results of the ordinal regression model, it becomes evident that bike-sharing became a more attractive mobility option for those who before the pandemic were travelling with private car as passengers. It also became more attractive for people who were already registered in bike-sharing systems before the pandemic, and therefore they had a greater tendency for travelling with shared bikes. This indicates the difficulty of attracting new users to sharing mobility options and active mobility if they have no prior exposure and experience with them. What is more, people who assess bike-sharing more positively regarding safety towards COVID-19 are much more likely to shift in bike-sharing usage. The results of the ordinal regression model highlight the essential role of perceived safety towards COVID-19 in the transport mode choice in the post-pandemic era. The abovementioned results lead to the conclusion that bike-sharing cannot expect a significant increase in the share of trips, at least in the case of Thessaloniki, but it can become a viable option for specific groups of people in times of a pandemic, and consequently, it can contribute to a city's resilience.

The identification of the important role of safety leads to the conclusion that specific actions emphasizing on travelers' safety towards COVID-19 are needed for bike-sharing systems in order to become a viable and preferable mobility option. In this direction, bike-sharing companies should: (a) apply technological solutions, such as mobile applications, for enhancing the automation in the processes of renting and returning a bike and eliminating the need of contact between the users and the staff, (b) disinfect the bikes either manually through spraying or preferably automatically through Ultraviolet disinfection modules that can be set up in the stations (in the case of dock-based systems) or in the public space (in the case of dockless systems). Regarding the bike manufacturers (but also e-scooter manufacturers), it is of great importance to use materials on which the virus has been proven less durable. Finally, if local authorities want to enhance the role of bike-sharing and cycling in general, in the post-COVID-19 era, they should develop additional kilometers of secure, comfortable, and direct bicycle lanes, which will facilitate social distancing between cyclists.

The main limitations concerning the data collection are the relatively small sample size, as well as the fact that the survey was carried out during summer, which may have an impact on respondents' attitudes towards cycling. Expanding the sample size and collecting additional data could assist in providing more evidence about the impact of COVID-19 on bike-sharing systems usage. An additional limitation of the present paper is the fact that people's attitudes and intentions are only examined, but not their actual behavior. Thus, future research will be based on rental data of the bike-sharing systems with the aim to identify differences in the usage patterns, between the pre- and the post-COVID-19 eras.

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Conflicts of Interest: The authors declare no conflict of interest.

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