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Mobility Patterns and Mode Choice Preferences during the COVID-19 Situation

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Abstract: The empirical research on the COVID-19 epidemic's consequences suggests a major drop in human mobility and a significant shift in travel patterns across all forms of transportation. We can observe a shift from public transport and an increase in car use, and in some cases also increase of cycling and (less often) walking. Furthermore, it seems that micromobility and, more generally, environmentally friendly and comanaged mobility (including shared services), are gaining ground. In previous research, much attention was paid to the mode choice preferences during lockdown, or early stages of the SARS-CoV-2 situation. The blind spot, and aim of this work, is how long observed changes in mode choice last and when or if we can expect the mode choice to shift back to the situation before the SARS-CoV-2 episodes. The research sample consisted of 636 cases; in total, 10 countries contributed to the sample examined in this study. The data were collected in two phases: the first in the spring of 2020 and the second in the fall of the same year. Results showed that respondents reduced mobility by car, local public transport and walking, but not bicycling during the lockdown, compared to the time before the pandemic started. When the easing came, respondents assessed their own use of the car and walking as almost back to normal. They also reported an increase in the use of public transport, but not reaching the level prior the pandemic by far. It seems that cycling was affected least by the pandemic; use of a bicycle hardly changed at all. As for the implication of our study, it is evident that special attention and actions will be needed to bring citizens back to public transport, as it seems that the impact of the pandemic on public transport use will last much longer than the pandemic itself.

Keywords: mobility; traffic psychology; COVID-19; mode choice

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1. Introduction

The authors of this study discussed changes in transportation mode use from a broad viewpoint, examined transportation mode changes and compared the distribution of the population in the modal groupings for the survey's time periods—before, during and after lockdown.

Several research initiatives looking into the effects of the COVID-19 outbreak have found that that there is a significant reduction of human mobility and significant changes in travel patterns [1]. Borkowski et al., (2021) noticed that during pandemics the travel time decrease was determined by the means of transport used to travel. Other authors showed that the number of daily trips per person was on average decreased by 50% during the lockdown. Trips on foot were increased, private car was mainly used for commuting and public transport modal shares were heavily reduced. Trip durations were generally increased, as travelling was considered a recreational activity per se [2].

Anke et al. studied *"the effects of this disruptive situation"* as they called the situation caused by the COVID-19 pandemic. They asked how and in what areas mobility behaviour in Germany changed during the COVID period, thereby looking at federal states with and without lockdown with the help of an online survey. The data showed a shift away from public transport and an increase in car use, walking and cycling [3]. This was also confirmed by Muley and colleagues, who showed that the public transportation mode share was considerably reduced and people preferred cars and active modes. These changes also showed positive impacts on air pollution [4]. Findings presented by colleagues in Sicily showed that the public transport demand for commuting trips was reduced by half in Sicily during the second period of the pandemic [5]. Eisenmann et al. studied general and individual changes in transportation mode usage and attitudes, with a focus on the bicycle, vehicle and public transportation [6]. Changes in the perception of individual mobility alternatives were also explored, with an emphasis on car-free households. The findings showed that during the highly constrained period of lockdown, public transportation lost ground, whereas individual means of transportation, particularly the private vehicle, grew in importance. According to Przybylowski et al. the pandemic made authorities all around the world react by issuing both advice and legal acts, which also had implications for outdoor mobility. The authors looked especially at the city of Gdansk (Poland). According to their study, 90% of the respondents limited the use of public transport. Three quarters of them planned to return to public transport when times become normal again while one quarter will possibly be lost for public transport [7]. The authors concluded that, therefore, authorities should start working on the image of public transport immediately, so that there is no further decline, and to make sure that the development pro public transport during the last decades before COVID is revitalised. An article by McKinsey [8] stated that before COVID-19, cost and convenience played the most important role for customers in their choice of transportation modes, while during the pandemic, reducing the risk of infections became the top reason for travellers' choices both concerning private and business trips. This change definitely puts public transport at a disadvantage. Empirical findings have showed that public users' emotional perceptions led them to restrict certain travel choices. Feelings of anxiety, fear and stress were the most common [9]. Abdullah et al., (2020) [10] confirmed that in normal circumstances, elements influencing mode choice, such as travel time savings, comfort, and cost, became less important during pandemics. However, the authors stated that public transport will remain in demand despite the risks of pandemic. According to the study's findings, efforts should be implemented to make public transportation safer during a pandemic. However, one can also see another focus of research on human mobility of behaviour. One of the few studies presented by Javid and colleagues also focused on "what lies behind the behaviour", showing that the perceived behavioural control and personal norms have negative correlations with public transport use during COVID-19 restrictions [11].

Bergantino et al. [12] studied "one of the few positive externalities" of the COVID-19 pandemic and changing micromobility. They stress that micromobility, as well as ecologically friendly and comanaged mobility in general, is gaining attraction. Bike-sharing has enjoyed double-digit growth rates in its different incarnations throughout Italy, in particular. It is a cost-effective solution with zero emissions, convenience, short-distance speed and health benefits for users. In addition, the authors looked at how consumer habits evolved over time, comparing them before and after the COVID-19 lockdown and emphasizing the health benefits for both potential and present users. However, the authors noted that, while fully recognising the positive implications related to the bike-sharing system, people still preferred using their cars [12].

Barbieri and colleagues [13] focused their research on comparing people's mobility before and during the restrictions and the associated risks. Their findings stated that significant mobility disruptions related to the restrictions enforced to tackle the COVID-19 pandemic pertained to all transportation modes and all travelling purposes, albeit the extent of the transformations was different. We can observe similar findings in the research

of Chan and colleagues [14], who studied risk attitudes and overall human mobility during the COVID-19 pandemic. They looked at the link between changes in human mobility during the COVID-19 outbreak and the average risk preferences of people in 58 countries. Almost all regions had a decrease in trips (mobility) to all locations other than residential sites, notably in the early weeks of the sample period. Authors also noted an increase in visits to parks, which might have been considered a "relatively safe environment" [14].

Some authors have a wider view in this respect, connecting risk attitudes not only to pandemic environment but to other hazards including terrorist attacks, public transport strikes or oil shortages. Colard et al. [15] focused on what the pandemic does to outdoor mobility of the French and if it is possible to learn about the control of greenhouse gas (GHG) emissions in transport. Restrictions and lockdowns reduced freedom of movement greatly, producing hindrances to larger parts of society. Health and economic consequences have not been fully assessed, yet. Colard et al. dealt with changes in mobility practices. They proposed to look at long-term effects, and that today's analyses only allowed to see temporary impacts [15]. When reflecting upon the possible effects of the COVID-19 pandemic, Van Exel and Rietveld [16] suggested looking at earlier disruptive events of medium/long term character or medium/long term consequences. The authors considered the consequences of public transport strikes that affect public transport every now and then. Such strikes may induce a change of one's habits. They analysed 13 studies in order to deal with this issue and summarised that such strikes tend to increase car use—including congestions—and to do mild but persisting long-term harm to public transport. This might also be the case as far as the ongoing COVID-19 situation is concerned. Nguyen-Phuoc et al. [17] also dealt with the disturbances of strikes in public transport. They asked 648 public transport users in Melbourne how such events affected them, and it showed that 43% of users shifted to the car. Sharpe and Tranter [18] dealt with potential impacts of disruptions (an oil crisis in their case) on children's independent mobility. More and more children were brought to school by car, cutting down their freedom to explore the city, reducing their bodily fitness and enhancing obesity (concerning the relevance of considering children see, e.g., Leden [19]). Oil shortage would make more experts and decision makers argue for speed reductions. The authors show that a holistic understanding of urban transport shows that reducing speeds also would support children's autonomous mobility, as parents would be less afraid for their children's safety, one frequent reason for transporting them by car. This study shows that there is a potential for disruptions to also have positive societal effects.

Based on the presented research, we identified and operationalised the research gap for this work, which explains the novelty of this work. In previous research much attention has been paid to the mode choice preferences during lockdowns, or early stages of the SARS-CoV-2 situation. The blind spot, or research gap in this respect, is how long observed changes in mode choice last and when or if we can expect the mode choice to shift back to the situation before the SARS-CoV-2 episodes. In other words, our work focuses on the longer lasting effects of the behavioural change with possible prediction of future behaviour. This is especially true for the mode choice shift away from the public transport. The other relevant aspects of this work, which fit with the widely discussed topic of climate change, are active travel modes and possible gains of SARS-CoV-2 situation in this respect.

Based on the identified research gap, we formulated the aim of this research as follows. The study aims to understand how the SARS-CoV-2 situation influenced the preferences of the different traffic modes during the early stages of a SARS-CoV-2 episode and to explore whether these changes have longer lasting effects. A special attention was paid to active traffic modes and public transport.

We formulated the following research questions:

Did the SARS-CoV-2 situation influence mode choice? If so, how?
Will mode choice changes during SARS-CoV-2 last even when the epidemiological situation gets better?
Will people fear using public transport and prefer other modes of transport?
What will be the effects on the individual car use? Will it replace public transport trips?

How will the SARS-CoV-2 situation affect active traffic modes—walking and cycling? Will these modes possibly replace trips by other modes—car and/or public transport?

2. Method

2.1. Sample

The sample consisted of 636 cases, compiled from various countries through a survey distributed on the Internet utilizing social media and applying the "snowball" method. The sampling, therefore, was random but not probabilistic.

The data were collected in two phases: the first in the spring of 2020 and the second in the fall of the same year. During the first phase, data were compiled of the periods before and during the health crisis provoked by the pandemic; the second phase consisted of data collected after 5 months of living with the pandemic situation (retest). Of the initial sample, the number in the case group which completed both phases was reduced to 456, due to a loss of cases which commonly occurs when retesting any same group of individuals after a prolonged period.

Once the compilation of data was completed, the countries which completed the two phases of the survey were selected. They included: Austria (AT), Czech Republic (CZ), Spain (ES), Croatia (HR), Italy (IT), Lithuania (LT), Portugal (PT), and Russian Federation (RU), Sweden (SE) and United Kingdom (UK). In total, 10 countries contributed to the sample examined in this study.

The distribution by gender resulted in 214 men, 419 women and 3 nonbinary or other.

In relation to age, the mean was 39.65 (median 37) years of age, with a minimum of 14 and maximum of 81 years of age, and a standard deviation of 15.56.

Most were full-time workers (351) and students (127), while 56 were part-time workers and 46 retired.

2.2. Instrument

Through a survey methodology, in different languages, data were collected on the frequency of use of 4 modes of transport: private car, local public transport, bicycle and walking. The survey was distributed and answered online in the different countries in which the study was carried out.

The answers were collected using a Likert-type 5-point answer scale, the possible answers of which were adapted to the characteristics of the question (e.g., *1, not at all; 2, seldom (few times a year); 3, a couple of times a month; 4, once or twice a week; 5, almost daily or daily*).

These questions were repeated for each of the periods measured (before, during and after 5 months under the pandemic).

The survey was divided into two parts, corresponding to the two phases of the study. The first phase, distributed in the spring of 2020, covered questions referring to the "before" and "during" periods of the pandemic, as well as the corresponding demographic data. The second phase, distributed during the fall of 2020 utilizing the list of email addresses collected in the first phase, covered questions related to that moment in time (after 5 months of living with the pandemic and the risk of contracting the disease).

In both phases and parts of the questionnaire, email addresses were requested from the respondents and an individual personal code was constructed for identification based on a series of personal questions (the day of the month of birth, the first two initials of the mother's name, . . .), which were repeated in both parts, given that the questionnaire was anonymous.

The email address given in the first part was used to send the second part of the survey to those who answered the first, during the second phase of the study. The email address, along with the individual personal code, was used to pair up each respondent to their answers to both parts of the survey.

2.3. Design

Randomized block design (RBD) was used, in which each nationality´s group of participants completed the three measurements at three distinct moments in time: before the pandemic, during the pandemic and after five months living with the pandemic situation.

This experimental design allows one to obtain representativeness with small and not very representative samples, since the total sample is divided into small groups (in our case the national samples) and the same procedure is applied in each one, so that all the groups go through the same effects or conditions (in our case the situations "before", "during" and "after" the health crisis—not after the threat of the pandemic, which still remained with less intensity then). Thus, this design minimizes the effects of systematic error, when the experimenter focuses exclusively on the differences between treatments or situations, in our case the effects of the COVID-19 threat.

The differences between the three moments in each of the aspects measured for each mode of transport were verified by means of graphs to show the evolution and tests of statistical significance.

To determine if the differences between the three moments were statistically significant, and given the ordinal character of the variables [20], nonparametric tests were applied:

- The Friedman test, equivalent to the analysis of variance, to check the statistical significance of the effect (over the time period);
- The Wilcoxon test (for related samples), to check the statistical significance between pairs of time periods: before–during and during–after. In these comparisons, the Bonferroni correction was applied to the decision (alpha).

3. Results

3.1. Private Car and Urban Public Transport

The two following graphs represent the evolution of the means and medians, comparing the three periods regarding the use of these two modes of transportation.

As illustrated in Figures 1 and 2, a reduction in usage is observed of both modes of transportation in the most critical period of the pandemic (during the health crisis), however, public transport was affected the most by the changes. The greatest reduction was produced between the before and during periods, while after 5 months (at the end of the health services crisis, marked by moments of hospital saturation) an increase is observed in the frequency of use, although not to the levels seen before the pandemic.

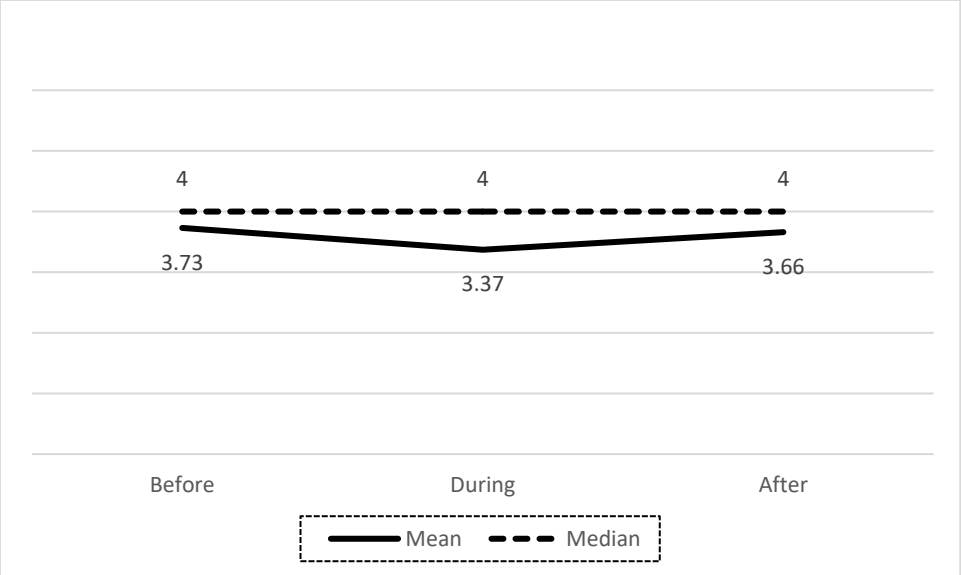

Figure 1. Means and medians of the responses on the frequency of use of private cars in the three evaluated time periods.

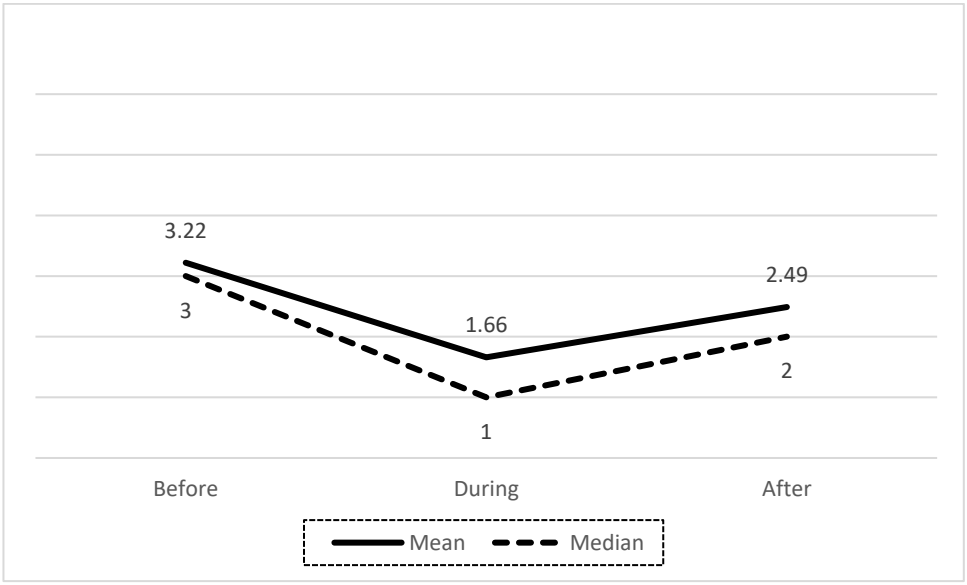

Figure 2. Means and medians of the responses on the frequency of use of urban public transport in the three evaluated time periods.

The following tables show the results of the Friedman tests.

As can be seen in Tables 1 and 2 summarizing the results of the Friedman test, the time period had a statistically significant effect on the use of both modes of transport. This leads us to affirm that the pandemic had a statistically significant influence on the frequency of use of both these transportation modes. Figures 1 and 2 illustrate such influence.

Table 1. Friedman test on private car use: before, during and after 5 months.

	N	Mean	St. Dev.	Percentiles			Mean Rank
				25	50 (Median)	75	
Before COVID health crisis I used a private car	636	3.73	1.377	3	4	5	2.11
During COVID health crisis I used a private car	632	3.37	1.386	2	4	5	1.79
Now (autumn 2020) I use a private car	456	3.66	1.377	3	4	5	2.10
Friedman's Test							
N (valid)					454		
Chi-square					59.238		
d.f.					2		
2-Tailed p					<0.0001		

To make a comparison between the different periods, before–during and during–after, the Wilcoxon test was utilized as stated in the Section 2.

In each of the following tables (Tables 3 and 4)we compared, by pairs, the time periods under examination, during with respect to before and after with respect to during. Since multiple comparisons were made, the Bonferroni correction was adopted for the alpha value.

All comparisons (before–during and during–after) were statistically significant for both modes of transport, which is to say, the decrease in usage resulting from the health crisis generated by the pandemic, with respect to usage before the crisis, was statistically significant for both modes of transport. The posterior increase in the frequency of use after 5 months of living with the risk of contagion with respect to the frequency of use during the health crisis was also statistically significant for both modes of transport.

Table 2. Friedman test on inner city public transport use: before, during and after 5 months.

	N	Mean	St. Dev.	Percentiles			Mean Rank
				25	50 (Median)	75	
Before COVID health crisis I used inner city transport	634	3.22	1.492	2	3	5	2.53
During COVID health crisis I used inner city transport	633	1.66	1.066	1	1	2	1.43
Now (autumn 2020) I use inner city transport	454	2.49	1.308	1	2	3	2.04
Friedman's Test							
	N (valid)				451		
	Chi-square				374.121		
	d.f.				2		
	2-Tailed p				<0.0001		

Table 3. Wilcoxon test comparing the use of private car between (each) 2 time periods.

I Use the Private Car		N	Mean Rank	Sum Ranks	Z	2-Tailed P
During COVID crisis vs. Before COVID crisis	Neg. ranks	221 [a]	160.14	35,390.00		
	Pos. ranks	88 [b]	142.10	12,505.00		
	Tied ranks	323 [c]				
	Total	632			−7.522	<0.0001
Now (autumn 2020) vs. During COVID crisis	Neg. ranks	70 [d]	105.84	7409.00		
	Pos. ranks	165 [e]	123.16	20,321.00		
	Tied ranks	219 [f]				
	Total	454			−6.465	<0.0001

[a] During COVID health crisis, I used the car < before COVID health crisis. [b] During COVID health crisis, I used the car > before COVID health crisis. [c] During COVID health crisis, I used the car = before COVID health crisis. [d] Now (autumn 2020), I use the car < during COVID health crisis. [e] Now (autumn 2020), I use the car > during COVID health crisis. [f] Now (autumn 2020), I use the car = during COVID health crisis.

Table 4. Wilcoxon test comparing the use of inner-city public transport between 2 time periods.

I Use Inner City Transport		N	Mean Rank	Sum Ranks	Z	2-Tailed P
During COVID crisis vs. Before COVID crisis	Neg. ranks	436 [a]	241.32	105,216.00		
	Pos. ranks	30 [b]	119.83	3595.00		
	Tied ranks	165 [c]				
	Total	631			−17.624	<0.0001
Now (autumn 2020) vs. During COVID crisis	Neg. ranks	38 [d]	136.38	5182.50		
	Pos. ranks	252 [e]	146.88	37,012.50		
	Tied ranks	163 [f]				
	Total	453			−11.442	<0.0001

[a] During COVID health crisis, I used inner city transport < before COVID health crisis. [b] during COVID health crisis, I used inner city transport > before COVID health crisis. [c] During COVID health crisis, I used inner city transport = before COVID health crisis. [d] Now (autumn 2020) I use inner city transport < during COVID health crisis. [e] Now (autumn 2020) I use inner city transport > during COVID health crisis. [f] Now (autumn 2020) I use inner city transport = during COVID health crisis.

These statistical tests (Friedman and Wilcoxon) added the condition of statistical significance to the variations observed between the three periods represented in Figures 1 and 2.

3.2. Cycling and Walking

The two following graphs represent the evolution of the means and medians, comparing the three periods regarding the use of these two modes of transportation.

As illustrated in Figures 3 and 4, the situation of the pandemic had less influence on these modes of transport (cycling, walking) than on the other two previously analysed (private car and urban public transport). Specifically, there was scarce or no influence on the use of a bicycle, and modest influence on the frequency of walking and/or its choice as a mode of transport, which suffered a slight reduction in usage during the most critical period of the pandemic (during the health crisis), surely due to the confinement measures.

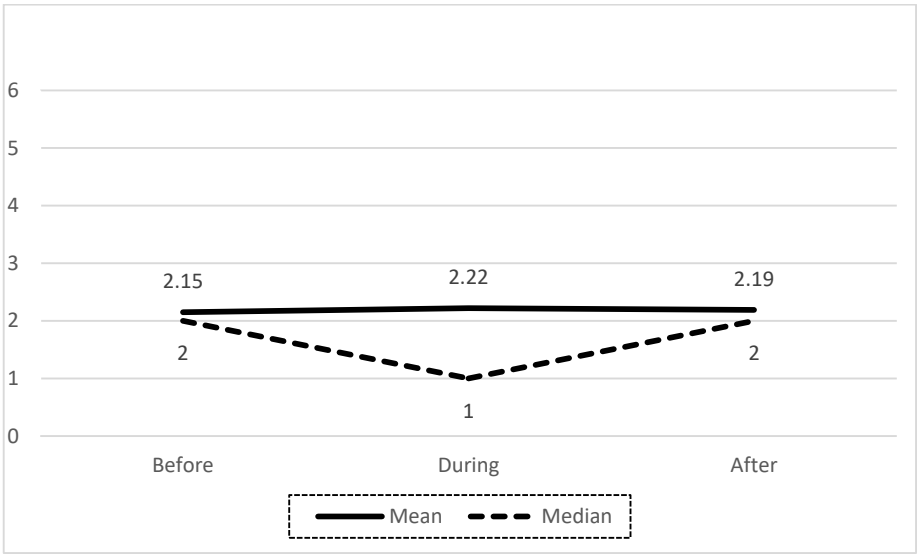

Figure 3. Means and medians of the responses on the frequency of use of a bicycle in the three evaluated time periods.

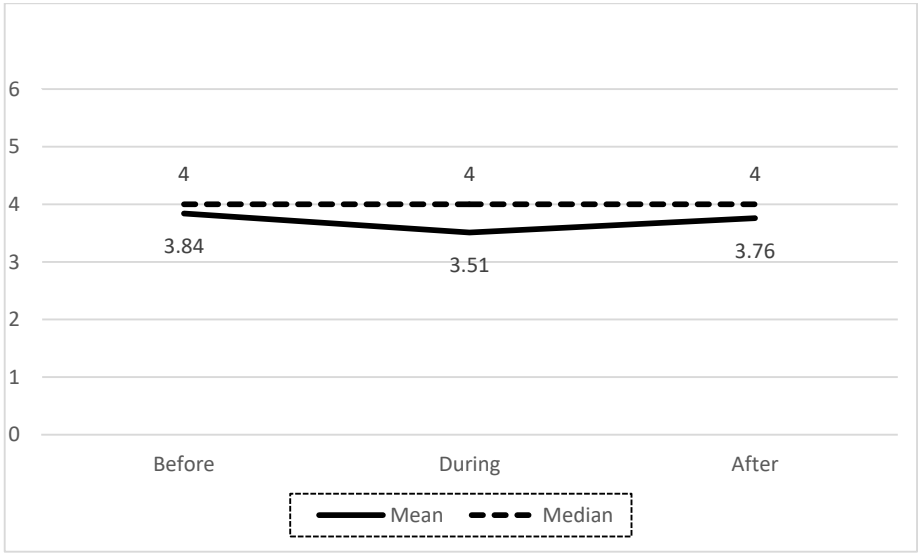

Figure 4. Means and medians of the responses on the frequency of use of walking in the three evaluated time periods.

The following Tables 5 and 6 show the results of the Friedman tests about the statistical significance of the pandemic situation effect on cycling and on walking, respectively.

Table 5. Friedman test on bicycle use: before, during and after 5 months.

	N	Mean	St. Dev.	Percentiles			Mean Rank
				25	50 (Median)	75	
Before COVID health crisis I used the bicycle	635	2.15	1.375	1	2	3	1.98
During COVID health I used the bicycle	631	2.22	1.452	1	1	4	2.03
Now (autumn 2020) I used the bicycle	456	2.19	1.345	1	2	3	2.00
Friedman's Test							
	N (valid)				453		
	Chi-square				1.355		
	d.f.				2		
	2-Tailed p				=0.508		

Table 6. Friedman test on walking use: before, during and after 5 months.

	N	Mean	St. Dev.	Percentiles			Mean Rank
				25	50 (Median)	75	
Before COVID health crisis I used walking	636	3.84	1.287	3	4	5	2.08
During COVID health crisis I used walking	631	3.51	1.395	2	4	5	1.86
Now (autumn 2020) I use walking	456	3.76	1.328	3	4	5	2.06
Friedman's Test							
	N (valid)				453		
	Chi-square				23.145		
	d.f.				2		
	2-Tailed p				<0.0001		

As can be seen in Table 5, the time period did not have a statistically significant effect of the use of bicycle as the main transportation mode. This leads us to affirm that the SARS-CoV-2 pandemic did not have a statistically significant influence on the frequency of cycling as a transportation mode. Figure 3 illustrates this result. The observed effect is not statistically significant.

Concerning the effect of the pandemic situation on the frequency of walking, Table 6 shows the Friedman's test results.

As can be seen in Table 6, the time period had a statistically significant effect on the use of walking as the main transportation mode. This leads us to affirm that the SARS-CoV-2 pandemic had a statistically significant influence on the frequency of walking as a transportation mode, but with less effect than the private car and urban public transport, especially with respect to this last. Figure 4 illustrates such influence.

To make a comparison between the different periods, before-during and during-after, the Wilcoxon Test was utilized as stated in the Section 2.

As in the former section, in each of the following tables (Tables 7 and 8) we compare, by pairs, the time periods under examination: during with respect to before and after with respect to during. Since multiple comparisons were made, the Bonferroni correction was adopted for the alpha value.

Table 7. Wilcoxon test comparing the use of bicycle between (each) 2 time periods.

I Use a Bicycle . . .		N	Mean Rank	Sum Ranks	Z	2-Tailed P
During COVID crisis vs. Before COVID crisis	Neg. ranks	95 [a]	98.93	9398.50		
	Pos. ranks	113 [b]	109.18	12,337.50		
	Tied ranks	423 [c]				
	Total	631			−1.757	=0.079 *
Now (autumn 2020) vs. During COVID crisis	Neg. ranks	109 [d]	111.32	12,134.00		
	Pos. ranks	100 [e]	98.11	9811.00		
	Tied ranks	244 [f]				
	Total	453			−1.380	=0.168

[a] During the COVID health crisis, I used a bicycle < before the COVID health crisis. [b] During the COVID health crisis, I used a bicycle > before the COVID health crisis. [c] During the COVID health crisis, I used a bicycle = before the COVID health crisis. [d] Now (autumn 2020), I use a bicycle < during the COVID health crisis. [e] Now (autumn 2020) I use a bicycle > during COVID health crisis. [f] Now (autumn 2020), I use a bicycle = during COVID health crisis. * Note: the Bonferroni correction established the alpha value at 0.025.

Table 8. Wilcoxon test comparing the frequency of walking between (each) 2 time periods.

I Use Walking as Main Transportation Mode		N	Mean Rank	Sum Ranks	Z	2-Tailed P
During COVID crisis vs. Before COVID crisis	Neg. ranks	211 [a]	168.45	35,542.00		
	Pos. ranks	111 [b]	148.30	16,461.00		
	Tied ranks	309 [c]				
	Total	631			−5.848	<0.0001
Now (autumn 2020) vs. During COVID crisis	Neg. ranks	107 [d]	129.76	13,884.00		
	Pos. ranks	168 [e]	143.25	24,066.00		
	Tied ranks	178 [f]				
	Total	453			−3.955	<0.0001

[a] During the COVID health crisis, I used walking as the main transportation mode < before the COVID health crisis. [b] During the COVID health crisis, I used walking as the main transportation mode > before the COVID health crisis. [c] During the COVID health crisis, I used walking as the main transportation mode = before the COVID health crisis. [d] Now (autumn 2020) I use walking as the main transportation mode < during the COVID health crisis. [e] Now (autumn 2020) I use walking as the main transportation mode > during the COVID health crisis. [f] Now (autumn 2020) I use walking as the main transportation mode = during the COVID health crisis.

Neither of the two pairs of comparisons (before–during and during–after 5 months) were statistically significant for the use of a bicycle, that is, there has not been a statistically significant decrease or increase between each time period compared to its previous.

Nevertheless, in the case of the use of walking as a transportation mode, both pairs of comparisons (before–during and during–after 5 months) were statistically significant, that is, both the decrease that occurs during the health crisis compared to before, and the increase that occurs after 5 months of living with the risk of contagion, compared to the previous moment, were statistically significant.

4. Discussion and Conclusions

A pandemic is a disruptive situation. Therefore, when trying to learn from the literature what the impacts of the SARS-CoV-2 pandemic could be, one can make use of both recent studies referring to the SARS-CoV-2 pandemic directly and to studies dealing with other disruptive situations, such as energy crises, long-term strikes, economic crises, etc. Such literature shows a reduction of human mobility and a significant change in travel patterns in such settings. According to some studies, during pandemics, the travel time and number of trips change. This affects all transportation modes, albeit the extent of the transformations is different. Some authors show that there tends to be a shift away from public transport and an increase in car use, walking and cycling. Specifically, the private car becomes more important, and there is an increase in visits to parks. Public transport loses ground and some of the customers will probably not return to public transport. On

the other hand, some studies show zero impact on walking and on cycling. This might be caused by a so-called ceiling effect: all (or mostly all) who considered walking or cycling as a transportation mode already did so before pandemics and those who stopped using public transport shifted to individual car use.

The literature also shows that the motives for mode choice changed. Before SARS-CoV-2, cost, convenience and safety played the most important role; during the pandemic, reducing the risk of infections became the top reason. Some studies indicate that environmentally friendly mobility is gaining ground, e.g., bike-sharing or other sharing services.

In our study, we wanted to find out both how the emerging pandemic influenced mode choice and mobility compared to the situation before the pandemic and how long the observed changes in mode choice would last when restrictions due to the pandemic are eased or fully removed. In our case, we dealt with an easing—not a full removal of restrictions—and based on our results, we can answer our research questions as follows.

Did the SARS-CoV-2 situation influence mode choice? If so, how? The respondents stated that they reduced mobility by car, local public transport and walking, but not bicycling during the lockdown, compared to the time before the pandemic started. It is necessary to note that mobility (number of trips) decreased also in total. These results are well comparable to what we learned from literature.

Will mode choice changes during SARS-CoV-2 last even when the epidemiological situation gets better? When the easing came, they assessed their own use of the car and walking as almost back to normal. They also reported an increase of the use of public transport, but not reaching the level prior the pandemic by far. Przybylowski et al. [7] predicted this in their study from the Polish city of Gdansk.

Will people fear using public transport and prefer other modes of transport? Our results indicate that this is the case. However, open-ended questions and answers are needed in order to understand whether motives like fear or other reasons lie behind the reduced use of public transport. In any case, the study of McKinsey [8] would corroborate the assumption that *fear* plays an important role. To answer this question in detail, further research with qualitative design (interviews or focus groups) is needed.

What will the effects be on individual car use? Will it replace public transport trips? From our results, we cannot decide whether there was a replacement of public transport use by car use. What we can say is that the respondents considered their car use during the easing phase as similar to before the pandemic started, which was not the case concerning their use of local public transport.

How will the SARS-CoV-2 situation affect active traffic modes (walking and cycling)? Will these modes possibly replace the use of other modes? According to the statements of the respondents, cycling was affected least by the pandemic. They indicated that their use of a bicycle hardly changed at all. They even reported an increase during the lockdown, though not significant, while the level during the easing was the same as the one before the lockdown. Walking as a transportation mode was considered as less prevalent during the lockdown. One could hypothesise that the reduced number of walks to the stops and stations of public transport contributed to this. One could also hypothesise that respondents did not fully consider leisure walks as "transport", while such leisure walks could well have increased in numbers, as Chan et al. [14] found in their study. In any case, respondents in our study perceived their mobility by walking as significantly reduced during the lockdown compared to before the pandemic, while they reported an increase almost to the status before the pandemic during the easing. We cannot answer the question whether walking and/or cycling replaced the use of other modes for sure, but one might certainly assume that some public transport trips were replaced by bicycling. Here, as well, more dialogue with the respondents is needed.

To sum up, one can say that, while car use, bicycling and walking recovered after the confinement, tending to return to their initial values before the pandemic, the use of local PT seems to have decreased significantly and will probably not return to its initial values for a long time.

4.1. Limitations of the Study

As for the limitations of the study, we consider the main limitation the fact that we used only Likert-scale questions, which categorize answers into five categories from "*not at all*" to "*almost daily*". This approach allows us to collect frequencies of mode choice but does not allow us to learn about the motives and other psychological factors, which "lie behind the behaviour" (e.g., motives, norms, beliefs, habits). Based on this, we can conclude how the behaviour (mode choice) changed, but we cannot explain why. As one and the same motive can lead to many different behaviours and one observed behaviour can have many motives, this shortcoming should be tackled by another future study.

The other limitation is the way we stated the baseline. We asked respondents about their mode choice before the pandemic situation (e.g., 2–3 months prior). Based on the literature (e.g., Maycock, Lockwood and Lester, 1991 [21]) we know that people are not very good at recollecting the past, even after just a few months.

Another limitation is that we have answers from only 636 persons from all over Europe. This is of course not sufficient to represent the mobility patterns of ten different countries. On the other hand, we could not find a single study that produced data that could be generalized. We have a large sample of answers from all over Europe and get an impression of the reactions of people to the prevailing situation, as far as their mobility behaviour is concerned. Our results may be seen in the context of all the studies carried out on this subject. In the discussion, we have inserted references that can help to put our results in perspective.

4.2. Implications of the Study

The implications of our study are in the field of urban mobility planning, especially in the field of public transport. It is evident, that special attention and actions will be needed to bring back citizens to public transport, as it seems that the impact of the pandemic on public transport use will last much longer than the pandemic itself. Furthermore, the fact that mode choice preference persists even when the crisis is over (or eased) shows that in all cases when supporting sustainable and active traffic modes, we cannot rely only on "getting back to normal", but we need to pay special attention to the promotion and support of a shift to a wished-for mode choice (see also Risser and Sucha, 2020, who elaborated on some suggestions on how this could be achieved [22]).

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