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Acceptability of sustainable mobility policies under a post-COVID-19 scenario. Evidence from Spain

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ABSTRACT
The COVID-19 pandemic has suddenly modified the lifestyle of a large portion of the population around the world. This pandemic is also the first one in decades that has severely impacted many countries of the Global North. Governments have had to adopt wide-scope and desperate measures to face the abnormal situation and to reduce the stress of their health care systems. These measures have been based on reducing the physical-social interaction and mobility (closing schools and some economic activities, or fostering telework, among others), increasing the physical distance between people, and recommending washing hands frequently and wearing masks. Thus, the COVID-19 may change many habits of people and the ways we interact with others after the current pandemic. It would also imply changes in mobility habits. Many questions arise about the willingness and acceptability of changes, and who would have to impulse them and how. This paper aims to study and understand individuals’ acceptability towards a set of generic measures related to urban mobility in Spain, one of the countries most affected by the COVID-19 pandemic. To that end, we conducted an online survey during the lockdown in Spring (2020). More than 75% of respondents would accept restrictions on car use after the return to normal, and more than 90% agree on increasing the space for pedestrians and cyclists on streets. Furthermore, 75% of respondents would change the primary transport mode towards a more sustainable transport mode if it would decrease the incidence or severity of the COVID-19. These results show that the respondents are overall in favor of a new urban hierarchy that gives more importance to the most sustainable modes, reducing the public space devoted to the car, which means the possibility of turning the COVID-19 crisis into an opportunity to make Spanish cities more sustainable.

1. Introduction and state of knowledge

The COVID-19, caused by the virus SARS-CoV-2, has impacted on the lifestyle of a large portion of the world’s population since the first months of 2020. The first confirmed cases appeared in Wuhan (China) in December 2019, and this disease swiftly spread across the globe. By 30 January 2020, the World Health Organization (WHO) declared COVID-19 as a Public Health Emergency of International Concern, or PHEIC. [2] Less than two months later, by 11 March of 2020, the WHO updated its status, declaring it as a worldwide pandemic. [3]

By the time the WHO declared the pandemic, the COVID-19 had already started severely affecting and sternly stressing the health care systems in several countries in the Global North, especially in Western Europe. Governments had to face an extraordinary situation and to
adopt wide-scope and desperate measures at local, regional, and even national levels to control the disease spread and flatten the curve of incidence. These measures tried to gain time until effective and accessible treatments, both for preventing and curing the disease, would be available. They were mainly based on generic Non-Pharmaceutical Interventions (NPIs), already used on the previous airborne pandemic such as influenza outbreaks (Aburto et al., 2010; Morse et al., 2006). Some of these measures consisted of: discouraging the physical-social interaction (closing schools and some economic activities, giving spatial lockdown, and household quarantines, or fostering telecommuting, among others), case tracking and isolations, restricting mobility and closing borders, encouraging to increase the physical distance between people, recommending frequent hand washing, and actively encouraging to wear masks in public spaces. As a result of the adoption of these severe measures, people suddenly had to change the ways they interacted with others and their mobility habits. “The heart of everything in contemporary life” (Hanson, 2006, p. 232), cities and transportation, unannounced had to slow down, reduce, even stop during several days of the pandemic. This situation may change societies during the pandemic, and many of these changes might also remain long after the pandemic ceases.

Cities have traditionally been pointed as critical pieces on modern pandemic outbreaks and spread processes. “Cities are seen as hotbeds of contagion as their dense built and social environments are considered conducive to disease transmissions” (Keil, 2009, p. 36). This concern has been increasing because of the growth of urban population, especially the explosion of the low-income population in slum neighborhoods without proper sanitary systems in the Global South, and the interconnection among the global cities, see (Ali and Keil, 2007; Alirol et al., 2011; Connolly et al., 2020; WHO, 2008; Zachreson et al., 2018).

Transportation plays a crucial role in disease spread processes nowadays. During the travel and their stays, infected people, with or without symptoms, may also infect other people, and recently infected people may continue spreading the disease far from where they were infected. Anisetti (2020) studied whether cities with the higher use rate of public transport were beaten harder by the COVID-19 pandemic. This analysis suggests that the intensity of the use of public transport in the EU cities may be one cause of the virus spread compared with US cities, except for high-density cities such as New York, Chicago, or Los Angeles. Cities and transportation networks were proven to be fragile due to different situations, ranging from extreme events such as natural or human-made disasters (hurricanes or terrorist attacks, among others), to minor regular events (congestion or pollution episodes). The scale, impact, frequency, and predictability of these abnormal events may also vary enormously. Network vulnerability can be defined as the susceptibility to disruptions that can cause a significant reduction of network services (Chen et al., 2007). Unlike other types of disasters, pandemics directly impact society without causing physical damages to infrastructure (Fletcher et al., 2014). Nevertheless, it is necessary to consider pandemics as another possible vulnerability for the transport networks (Rodrigue et al., 2013).

Even though these abnormal situations may be conditioned as unpleasant events, their disruptive nature may be used as an opportunity to introduce policies to foster modal shifts to more sustainable mobility patterns. The cities’ response due to disasters, such as pandemics, has been a hot topic in city governance (Kapucu, 2012; Keil and Ali, 2007) and biopolitics in some cities, especially in Asia, were global cities such as Hong Kong (Füller, 2016) or Singapore (Alirol et al., 2011; Heng, 2013) have been studied for pandemic risk assessments. However, many questions arise about the willingness and acceptability of changes in cities and transportation and who would have to impel them and how. Research on acceptability towards security measures for preventing terrorism reported that preserving the network’s free flow and capacity is crucial for passengers and operators (Kapppa et al., 2009), but as the COVID-19 pandemic situation analogous with terrorism? As well as happened in the past, modern city planning may be a tool for pandemic resistance cities (Alirol et al., 2011; Mehmod, 2016). As more people are aware of the risk of exposition to a contagious disease of mass transport services, such as metro systems, outdoor public space redistribution might be considered as a way to foster pandemic resilient cities by switching to more active and sustainable mobility patterns such as cycling and walking.

The COVID-19 pandemic has been singular in many aspects. Recent pandemics such as SARS-CoV-1 (2003), H5N1 (2005), and H1N1 swine flu (2009) had severe effects on the global population. Nevertheless, the impact of the SARS-CoV-2 is unprecedented in modern times due to the worldwide paralyzation to avoid its rapid spread. Among all the singularities of the COVID-19 pandemic, we can mention the severity of its impact on multiple countries. Spain has been one of the most affected countries in Western Europe, with one of the highest impact ratios worldwide: more than 270,000 total cases at the end of July 2020 (Johns Hopkins University, 2020), the number of cases during the “first wave”. It means almost 6000 cases per million inhabitants. The Spanish government decreed a sudden and almost complete national lockdown on March 15, 2020 and imposed severe mobility restrictions, one of the most drastic in Western Europe. As a result of the lockdown, mobility dropped 75% (MITMA, 2020), mobility to workplaces dropped up to 80% regarding the pre-COVID-19 regular situations (Google, 2020), and a more severe reduction observed for transit than car mode (Apple, 2020). Spain also reported the lowest vehicle miles traveled (VMT) of Europe, only 12% of the pre-COVID-19 VMT by the week of 6 April (INRIX, 2020).

The lockdown in Spring (2020) was partially loosened between May 2020 and the end of June 2020, and a “new normality” period has been regulating life in Spain since then. “New normality” allows national and regional governments to adopt some restrictions, including severe mobility restrictions, and impose other person-based NPIs, depending on their epidemiological trends. Mobility dynamics have tended to recover previous trends slowly since the partial lifting of the lockdown, May 2020, but transit modes have been performing noticeably worse. Mobility trends suffered some disruptions in Fall (2020) because Spain was suffering the “second wave” and governments adopted some measures restricting mobility. “New normality” has been an irregular period. However, transit modes seemed to slightly increase ridership in this wave but still below pre-COVID-19 ridership (Apple, 2020).

Despite the novelty of the COVID-19, some papers have already studied its incidence in Spain on partial aspects. For instance, previous contributions have explored mobility changes during the lockdown period (Aloi et al., 2020) or how transportation, built environment, and density might have spread it (Pazet al., 2020).

We identified a gap in the transport policy research by these drastic changes in mobility behavior driven by the extraordinary pandemic situation. This paper is based on Binary Logit model results, performed with data obtained by a nationwide online survey in Spain. It was launched on April 28, 2020, and it was available for two weeks when the lockdown was still enforced in the country. This paper aims to make the first approach to the stated effect on mobility and the changes in behavior patterns in a future post-pandemic “entire normality” resulting from the pandemic situation caused by COVID-19, and to propose policy recommendations to foster sustainable changes.

The paper is structured as follows: Section 2 shows the methodology, the modeling approach, and the first finding of the descriptive analysis of the survey. Section 3 describes the modeling results and the main discussion about them. The last section presents conclusions and policy implications.

2. Methodology

A Spanish-wide online explorative survey was launched on April 28, 2020, until May 12, 2020, during Spain’s lockdown. The call to participate in this survey was only published on digital social networks, such as Twitter, Facebook, or LinkedIn because restrictions did not allow us to approach potential respondents personally. Due to that critical
limitation on the sample definition, we only filtered questionnaires as complete (valid) or incomplete. We obtained a total of 984 valid responses. The survey was broadly structured in three sections: (1) sociodemographic questions, (2) mobility behavior under normal conditions, previous to the COVID-19 pandemic, and (3) mobility patterns after the lockdown, with the risk of COVID-19 as a decisive factor for mode and measures adoption.

The survey contained two types of questions: Revealed Preferences (RP) and Stated Preferences (SP). Questions of sections 1 and 2 were RP-type questions. They aim to characterize the respondent and travel behavior by asking about their work and family situation, the travel frequency according to the purpose of the trip, and the mode of transport frequently chosen for each specific trip purpose. For each activity purpose, individuals reported whether they conduct this activity in an intensive (considered as more than once per week) or occasional/non-intensive way (considered as once per week or less). The individuals reported their ZIP code of residence. We gathered individuals’ responses to building a new explanatory variable concerning the size of the metropolitan area, with three main categories: i) big metropolitan areas (above 2 million inhabitants); ii) medium-sized metropolitan areas (between 1 and 2 million inhabitants); and iii) small metropolitan areas (below 1 million inhabitants).

The aim of SP-type questions, in section 3, is to foresee a reference to the changes in the habits, in the frequency of the trips according to the purpose of the same ones, and to determine the acceptance of specific management measures. The policy questions relate to:

1) Whether the individual would accept the implementation of further restrictions to the use of cars,
2) Whether the individual would accept increasing the urban space devoted to pedestrian and bike mobility, even in this case this implies reducing the space devoted to motorized mobility,
3) Whether the individual would be willing to shift to a more sustainable transport mode in the post-COVID-19 period.

Finally, some control questions were also included to detect potential inconsistencies between the respondent’s answers. The results provided the ground for policy-making directed to maintain the sustainability of the transport system.

The set of variables collected in the questionnaire is shown in Table 1:

### 2.1. Modeling approach: a Binary Logit framework

To explore individuals’ acceptability towards several transportation-related measures, we adopt a choice modeling framework according to responses of the questions of the last section of the survey. These are binary responses and are explored with Discrete Choice Models (DCM). To know more about DCMs applied to transport research, the reader is referred to e.g., Ben-Akiva and Lerman (1985) and Ortúzar and Willumsen (2011).

#### 2.2. First findings of the survey

By sex, 60% were male, 39% female and 1% decided not to respond. By age, 1% are between 16 and 18, 18% between 19 and 30, 54% between 31 and 50, 22% between 51 and 64 and 4% over 65 (current retirement age in Spain). The majority of responses were captured in big metropolitan areas (61.4% of the sample).

As shown in Table 2, respondents were quite pessimistic about their expected situation in the post-COVID-19 period, the number people who would lose their jobs or cannot work and study at the same time increases notoriously. These results might affect the mobility patterns of the cities.

Regarding the post-COVID-19 work modality, 38% of respondents who would work after pandemic expected to be able to telework, 38% expected to travel towards her/his workplace, and 24% did not know. These results are related to the foreseen commuting frequency, as shown in Table 3. Traveling to the workplace every day drops by 30%, but traveling there for some times a week increases by 16%. Other activities would also reduce their frequency. For instance, traveling for shopping/ grocery and leisure switch from frequent activity (every day or some times a week) to infrequent activity, but almost none of the respondents considered to avoid trips for this purpose, and just 7.5% of respondents would expect to avoid trips for any other purpose. Otherwise, respondents expected to increase the trip frequency for caring people.

Regarding transport modal share (Table 4), individuals’ responses show a potential modal switch towards individual and not shared modes. On the one hand, respondents reported they would reduce their trips on public transport, especially for “work/study” (−11.6%), “leisure” (−8.8%) and “shopping/grocery” (−5.4%) purposes; while the use
of shared transport modes is expected to reduce slightly. On the other hand, they would increase walking trips and trips by private bicycles and scooters, especially walking for “leisure” purposes (+4.5%), and traveling to “work/study” (+5%) and for “leisure” (+3%) by private bicycles and scooters. Finally, private cars and motorcycle are expected to not variate, with a slight increase in “work/study” trips (1.2%). 20% of respondents would change transport mode because of the COVID-19 contagion risk, and 14% because they expect less traffic congestion.

These results were expected, especially given the high uncertainty regarding the future employment situation and also the limited information available about the virus at the time the survey was launched. Thus, in addition to characterize the respondent with the revealed preferences and unveil the future mobility patterns with the stated preferences, an additional series of questions have been asked to explore which measures would be the most accepted among a set of measures that impulse the use of more sustainable means of transport.

3. Changes in willingness and acceptability

In order to explore individuals’ acceptability towards specific transport policy measures aimed at improving urban sustainability, we adopt a choice modeling framework. To that end, we exploit the data
collected from the survey. As noted in Section 2, three main binary variables collected in the survey are modeled in this research: i) acceptability towards establishing further restrictions to the use of cars; ii) acceptability towards increasing the urban space devoted to pedestrian and bike mobility, even in the case this implies reducing the space devoted to motorized mobility; and iii) willingness to shift to a more sustainable transport mode in the post-COVID-19 period. Firstly, we briefly report some preliminary findings on individuals’ opinions towards these transport options. Next, we show the results obtained from the choice modeling framework.

### 3.1. Preliminary findings

Before reporting the results of the Logit models, preliminary findings are displayed concerning the three key aspects addressed in the survey (see Table 5). As can be observed, overall acceptability is relatively high for the three transport options. More than three-quarters of respondents show a positive attitude towards establishing further governmental restrictions to the use of cars in urban areas (76.4%) and would be willing to adopt a more sustainable transport mode in the post-COVID-19 period (75.8%). It should be noted that increasing public space devoted to pedestrian and bike mobility reaches a very high degree of support among respondents (92.6%).

Regarding the first policy measure (further governmental restrictions to car use), it seems that support is somewhat higher among respondents riding a bike for commuting (between 79.6% and 100%, depending on the frequency of trip) and for leisure purposes (95.7%). By contrast, individuals driving their own vehicle for leisure (between 64.7% and 79.1%) show a lower level of support.

### Table 5
Individually’s acceptability towards several transport measures: % of positive responses.

| Variables                        | Restriction to car use | Increase of pedestrian areas | Shift to a more sustainable mode |
|----------------------------------|------------------------|------------------------------|----------------------------------|
| Sociodemographics                | Monthly Income         |                              |                                  |
| Below 500 Euro                  | 74.0%                  | 87.7%                        | 78.1%                            |
| 500 to 1000 Euro                | 80.2%                  | 94.2%                        | 81.4%                            |
| 1000 to 1500 Euro               | 79.1%                  | 94.4%                        | 74.5%                            |
| 1500 to 2000 Euro               | 80.0%                  | 96.1%                        | 81.0%                            |
| 2000 to 3000 Euro               | 73.2%                  | 92.9%                        | 74.7%                            |
| Above 3000 Euro                 | 69.5%                  | 82.9%                        | 63.4%                            |
| Age                             |                         |                              |                                  |
| Under 30                        | 76.7%                  | 93.7%                        | 78.0%                            |
| 30 to 49                        | 75.6%                  | 92.4%                        | 73.3%                            |
| 50 to 64                        | 79.2%                  | 92.9%                        | 82.0%                            |
| Above 64                        | 70.3%                  | 89.2%                        | 67.6%                            |
| Occupation                      |                         |                              |                                  |
| Employed, no teleworking        | 73.5%                  | 91.4%                        | 74.5%                            |
| Employed (teleworking)          | 78.9%                  | 93.0%                        | 74.6%                            |
| Other                           | 77.3%                  | 93.8%                        | 78.9%                            |
| Size of the metropolitan area   |                         |                              |                                  |
| Big cities                      | 77.1%                  | 89.9%                        | 73.4%                            |
| Medium-size cities              | 74.2%                  | 95.5%                        | 78.7%                            |
| Small cities                    | 76.4%                  | 98.1%                        | 80.3%                            |
| Mobility habits                 |                         |                              |                                  |
| Commuting                       |                         |                              |                                  |
| Intensive, public transport     | 79.2%                  | 91.3%                        | 76.2%                            |
| Intensive, private car/moto     | 66.5%                  | 89.9%                        | 70.6%                            |
| Intensive, bike                 | 93.8%                  | 96.3%                        | 81.3%                            |
| Intensive, walking              | 79.6%                  | 97.8%                        | 80.6%                            |
| Intensive, other                | 66.7%                  | 86.7%                        | 80.0%                            |
| Non-intensive, public transport | 90.5%                  | 100.0%                       | 90.5%                            |
| Non-intensive, private car/moto | 70.0%                  | 90.0%                        | 75.0%                            |
| Non-intensive, bike             | 100.0%                 | 100.0%                       | 63.6%                            |
| Non-intensive, walking          | 92.3%                  | 100.0%                       | 84.6%                            |
| Non-intensive, other            | 78.2%                  | 80.0%                        | 80.0%                            |
| Leisure                         |                         |                              |                                  |
| Intensive, public transport     | 82.9%                  | 94.3%                        | 78.0%                            |
| Intensive, private car/moto     | 64.7%                  | 91.7%                        | 67.7%                            |
| Intensive, bike                 | 95.7%                  | 97.8%                        | 82.8%                            |
| Intensive, walking              | 76.2%                  | 93.0%                        | 78.0%                            |
| Intensive, other                | 66.7%                  | 93.3%                        | 66.7%                            |
| Non-intensive, public transport | 78.5%                  | 91.1%                        | 75.9%                            |
| Non-intensive, private car/moto | 59.6%                  | 81.9%                        | 67.0%                            |
| Non-intensive, bike             | 95.7%                  | 100.0%                       | 91.3%                            |
| Non-intensive, walking          | 84.3%                  | 98.0%                        | 84.3%                            |
| Non-intensive, other            | 68.3%                  | 83.3%                        | 75.0%                            |
| Shopping                        |                         |                              |                                  |
| Intensive, public transport     | 79.5%                  | 95.5%                        | 81.8%                            |
| Intensive, private car/moto     | 60.4%                  | 91.1%                        | 76.2%                            |
| Intensive, bike                 | 100.0%                 | 100.0%                       | 85.7%                            |
| Intensive, walking              | 86.1%                  | 94.8%                        | 80.0%                            |
| Intensive, other                | 80.0%                  | 76.7%                        | 75.4%                            |
| Non-intensive, public transport | 76.7%                  | 90.4%                        | 72.6%                            |
| Non-intensive, private car/moto | 65.4%                  | 87.4%                        | 67.3%                            |
| Non-intensive, bike             | 90.9%                  | 90.9%                        | 63.6%                            |
| Non-intensive, walking          | 77.9%                  | 95.0%                        | 77.3%                            |
| Non-intensive, other            | 66.7%                  | 78.9%                        | 79.9%                            |
| Children/elder assistance       |                         |                              |                                  |
| Intensive, public transport     | 72.7%                  | 90.9%                        | 72.7%                            |
| Intensive, private car/moto     | 61.9%                  | 90.5%                        | 61.9%                            |
| Intensive, bike                 | 83.3%                  | 100.0%                       | 83.3%                            |
| Intensive, walking              | 76.0%                  | 92.0%                        | 72.0%                            |
| Intensive, other                | 85.1%                  | 93.1%                        | 87.1%                            |
| Non-intensive, public transport | 89.7%                  | 89.7%                        | 82.8%                            |
| Non-intensive, private car/moto | 62.6%                  | 89.9%                        | 75.8%                            |
| Non-intensive, bike             | 90.5%                  | 95.2%                        | 90.5%                            |
| Non-intensive, walking          | 70.2%                  | 93.6%                        | 70.2%                            |
| Non-intensive, other            | 90.9%                  | 100.0%                       | 90.9%                            |
| Total                           | 76.4%                  | 92.6%                        | 75.8%                            |
59.6%) or shopping (between 60.4% and 65.4%) show noticeable lower support. Additionally, acceptability tends to be lower among high-income levels.

As noted above, increasing the urban space devoted to pedestrian and bike mobility seems to be a policy highly supported across respondents. However, we should note that individuals who travel non-frequently for leisure purposes, and use their private car for these trips present noticeable lower acceptability (81.7%). Regarding the third question, from Table 5 we can observe that the willingness to use a more sustainable transport mode in the post-COVID-19 period reduces with the level of income. This result may reflect the more reliable car prone behavior of this segment of the population. It should also be noted that individuals who use their private vehicle for leisure purposes (regardless they make this type of trips frequently or not) seem to be less willing (between 67.7% and 67.0%) to shift to a more sustainable mode of transport. This result may be connected to the preference for the comfort of these individuals when traveling for shopping.

In order to analyze individuals’ opinions more rigorously, a Binary Table 6

| Variables (base reference) | a. Restriction to car use | B. Increase of pedestrian & bike areas | C. Shift to a more sustainable mode |
|----------------------------|---------------------------|---------------------------------------|------------------------------------|
|                             | Coeff. | p-value | Coeff. | p-value | Coeff. | p-value |
| **Sociodemographics**       |        |         |        |         |        |         |
| Monthly Income (below 500 Euro) |        |         |        |         |        |         |
| 500 to 1000 Euro            | 0.880  | 0.097   |        |         |        |         |
| 1000 to 1500 Euro           | 1.044  | 0.009   | 1.044  | 0.009   |        |         |
| 1500 to 2000 Euro           | 1.473  | 0.001   | 1.473  | 0.001   |        |         |
| 2000 to 3000 Euro           | −0.432 | 0.039   | 0.856  | 0.022   | −0.460 | 0.036   |
| Above 3000 Euro             | −0.505 | 0.081   |        |         | −0.451 | 0.043   |
| Income change               | −0.275 | 0.097   | −0.275 | 0.097   | −0.289 | 0.049   |
| Age (under 30)              |        |         | 0.472  | 0.040   | 0.691  | 0.004   |
| 30 to 49                    |        |         |        |         |        |         |
| 50 to 64                    |        |         |        |         |        |         |
| Above 64                    |        |         |        |         |        |         |
| Occupation (employed, no teleworking) | 0.378 | 0.049   |        |         |        |         |
| Employed (teleworking)      |        |         |        |         |        |         |
| Size of the metropolitan area (base case: big city) |        |         | 1.131  | 0.008   | 0.328  | 0.242   |
| Medium-size city            |        |         |        |         |        |         |
| Small city                  |        |         | 1.956  | 0.002   | 0.402  | 0.097   |
| Non-intensive, public transport | 0.275 | 0.097   | 0.275  | 0.097   |        |         |
| Non-intensive, private car/moto | 0.275 | 0.097   | 0.275  | 0.097   |        |         |
| Non-intensive, bike         | 1.357  | 0.058   |        |         |        |         |
| Non-intensive, walking      | −1.022 | 0.117   |        |         |        |         |
| Non-intensive, other        |        |         |        |         |        |         |
| **Mobility habits**          |        |         |        |         |        |         |
| Commuting (base case: intensive, public transport) |        |         |        |         |        |         |
| Intensive, private car/moto | 0.939  | 0.059   |        |         |        |         |
| Intensive, walking          |        |         | 1.357  | 0.058   |        |         |
| Intensive, other            |        |         |        |         |        |         |
| Non-intensive, public transport | −0.558 | 0.036   | −0.558 | 0.036   |        |         |
| Non-intensive, private car/moto | −0.558 | 0.036   | −0.558 | 0.036   |        |         |
| Non-intensive, bike         | 0.939  | 0.059   |        |         |        |         |
| Non-intensive, walking      | −1.022 | 0.117   |        |         |        |         |
| Non-intensive, other        |        |         |        |         |        |         |
| Leisure (base case: intensive, public transport) |        |         |        |         |        |         |
| Intensive, private car/moto | −0.764 | 0.007   | −1.327 | 0.000   | −0.508 | 0.056   |
| Intensive, bike             | 1.923  | 0.000   | 1.923  | 0.000   | 1.552  | 0.000   |
| Intensive, walking          |        |         |        |         |        |         |
| Intensive, other            |        |         |        |         |        |         |
| Non-intensive, public transport | −2.077 | 0.029   | −1.572 | 0.026   | −2.022 | 0.037   |
| Non-intensive, private car/moto | −2.077 | 0.029   | −1.572 | 0.026   | −2.022 | 0.037   |
| Non-intensive, bike         | −0.872 | 0.001   | −0.872 | 0.001   | −0.526 | 0.017   |
| Non-intensive, walking      | −0.507 | 0.043   |        |         |        |         |
| Non-intensive, other        |        |         |        |         |        |         |
| Children/elder assistance (base case: intensive, public transport) |        |         |        |         |        |         |
| Intensive, private car/moto | −0.619 | 0.016   | −0.619 | 0.016   |        |         |
| Intensive, bike             | 0.113  | 0.121   |        |         |        |         |
| Intensive, walking          |        |         |        |         |        |         |
| Intensive, other            |        |         |        |         |        |         |
| Non-intensive, public transport | −0.734 | 0.044   | −0.734 | 0.044   |        |         |
| Non-intensive, private car/moto | −0.734 | 0.044   | −0.734 | 0.044   |        |         |
| Non-intensive, bike         |        |         |        |         |        |         |
| Non-intensive, walking      | −0.673 | 0.052   |        |         |        |         |
| Non-intensive, other        |        |         |        |         |        |         |
| Constant                    | 1.923  | 0.000   | 1.618  | 0.000   | 1.552  | 0.000   |
| No. Obs                     | 840    | 840     | 840    | 840     | 840    | 840     |
| Log-Likelihood              | −404.61| −192.11 | −431.63| −431.63 | −431.63| −431.63 |
| Pseudo R²                   | 0.113  | 0.121   | 0.066  | 0.066   | 0.066  | 0.066   |

S. Awad-Núñez et al.
Logit framework has been adopted regarding three different measures (see Subsections 3.2 to 3.4). Prior to presenting the modelling results, some preliminary clarifications are provided since they are common to the three models. Explanatory variables used in the modelling were mostly categorical, so (when needed) a base reference has been chosen for each variable for the proper interpretation of the results. Base references chosen for each variable are included in Table 6. Regarding mobility habits, we should point out that the base case chosen in all cases comprises those individuals conducting a specific activity with a high frequency (3 or more times per week), and traveling by public transport for conducting these activities. In this respect, public transport has been chosen as the reference mode since it might represent an intermediate position in terms of sustainability between the private vehicle (car/moto) and active modes (bike and walking), also reported in the survey. Regarding individual socio-demographics, the monthly income base reference is below 500€, the age base reference category is below 30 years old, and the base reference category in occupation is employed but not teleworking. Before calibrating the Binary Logit models, we conducted multicollinearity tests for checking the presence of a strong correlation among the explanatory variables, according to, e.g., Gujarati and Porter (2004). The analysis showed no multicollinearity problems in our data.

3.2. Acceptability towards establishing further governmental restrictions to car use

The results from the Logit model exploring individuals’ acceptability towards establishing further governmental restrictions to the use of cars in the post-COVID-19 period are included in column A of Table 6. As can be observed, most of the explanatory variables that resulted in non-statistically significant were finally removed from the last version of the model. To that end, we conducted multiple likelihood-ratio (LR) tests during the calibration process, to check that certain explanatory variables could be omitted with no impact in the overall fitting or the explanatory power of the model.

Regarding individual socio-demographics, we can observe that modeling coefficients are statistically significant for income levels between 2000 and 3000 Euro (p-value = 0.039), and almost significant for individuals above 3000 Euro (p-value = 0.081). This result may reflect the higher car prone attitude of this segment of the population or the fact that these individuals typically live in disperse areas with lower accessibility to public transport services. This trend is also reinforced by the modeling results on the variable that controls for the change in the level of income after the COVID-19 lockdown (coefficient = −0.275; p-value = 0.091).

Interestingly, teleworking habits significantly influence the acceptability of this measure. According to the modeling results, the odds in favor of the measure for individuals who are employed and telework are, ceteris paribus, 45.9% more likely to accept further governmental restrictions on car use. This finding is reasonable, given that this segment of the population, or the lower accessibility of their residence location (quality residential areas in the outskirts, typically car-captive) by other modes of transport different from the private car.

Concerning mobility habits, several categories resulted in statistically significant in explaining individuals’ acceptability towards the measure. As seems reasonable, individuals driving their private vehicles are the segment of the population with lower support towards further car use restrictions since they would be the segment more negatively affected. Additionally, it is found that the size of the city is not statistically significant regarding the preference to restrict car use, which implies that this measure is equally accepted throughout cities.

Results are statistically significant and negative for respondents traveling by car, for both leisure and shopping purposes, regardless of the trip frequency. These results would imply the higher inelasticity shown by car drivers when making non-commuting trips. Compared to the base reference (high frequency of activities and use of public transport), the odds in favor of the measure among, e.g., people frequently shopping and using their private car decreases by 69.6%. It should be noted that modeling results are not statistically significant for people commuting by car. In the same line, acceptability is significantly lower among people frequently traveling for shopping purposes and using “other” modes. This result seems reasonable since this category includes taxi, ride-hailing, and car-sharing mobility, which would be negatively affected by the implementation of this measure.

Further interesting results are found for mobility habits comprising other transport modes. The higher support is observed among bike drivers. According to the modeling results, compared to the base reference, the support towards establishing further restrictions to the use of private vehicles is positive and statistically significant among people frequently traveling by bike for leisure (coefficient = 1.225; p-value = 0.026) and almost significant for commuting purposes (p-value = 0.059). For instance, the odds in favor of the measure are 2.4 higher for people frequently traveling for leisure purposes and traveling by bike. This result is interesting, since bike transport is the segment of mobility directly competing with motorized mobility for the public space, and the more benefited segment with the hypothetical implementation of this measure. Finally, the only statistically significant results for pedestrian transport mobility indicates lower acceptability for those individuals traveling on foot and occasionally (once per week or less) conducting children/elder assistance (p-value = 0.044) or shopping activities (p-value = 0.043).

3.3. Acceptability towards increasing the urban space devoted to pedestrian and bike mobility

As noted above, this transport policy reaches a high level of acceptability among respondents, with an average value of 92.6%. According to the modelling results (see Table 6, column B), only a handful of explanatory variables are statistically significant, what reflects the overall acceptability of this measure. Regarding individual socio-demographics, the only statistically significant variable in level of income. Individuals with a higher level of income present higher acceptability towards this measure, except for the top-ranked category (monthly income above 3000 Euro). This result may indicate that, as the level of income increases, individuals would be favorable to urban spaces more livable and with higher environmental quality characteristics. Again, the non-significant coefficient for wealthiest individuals would indicate the higher car prone attitude of this segment of the population, or the lower accessibility of their residence location (quality residential areas in the outskirts, typically car-captive) by other modes of transport different from the private car.

Concerning mobility habits, the only statistically significant coefficient is obtained for individuals conducting leisure activities occasionally (once per week or less) and traveling by private car or moto for this trip purpose (p-value = 0.000). For these respondents, the odds in favor of devoting more urban space to pedestrian or bike mobility is 69.5% lower, compared to the base reference. Two additional results are close to being statistically significant. Firstly, higher acceptability among those people frequently commuting on foot (p-value = 0.065), as seems reasonable. Secondly, lower acceptability for those individuals frequently traveling by “other” modes for shopping purposes. The latter would be affected by this measure in case the new space for pedestrians and bikers requires reducing the space devoted to cars. Concerning the size of the metropolitan area, the model shows that smaller cities present higher support for this measure (p-value = 0.008 for medium-sized cities and p-value = 0.002 for small cities).
3.4. Willingness to shift to a more sustainable transport mode in the post-COVID-19 period

Modeling results concerning individuals’ willingness to adopt a more sustainable transport mode in the post-COVID-19 period (compared to the pre-COVID-19 period) can be observed in Table 6, column C. Only specific categories within explanatory socioeconomic variables resulted in statistically significant. Firstly, the willingness to adopt more sustainable modes decreases with the level of income, especially for those individuals whose monthly income is above 3000 euro (p-value = 0.000). For this segment, the odds in favor of shifting to a more sustainable transport mode reduces by 64.1%, compared to the base reference. This result would be strengthened by the modeling coefficient obtained for the “Income change” variable (coefficient = −0.33; p-value = 0.046), which controls for the change in the level of income after the COVID-19 lockdown. Again, these results would indicate the higher car prone attitude of wealthy people, and the car-captive nature of their residential location. Respondents aged between 50 and 64 shows a statistically significant (p-value = 0.001) higher propensity to adopt more sustainable transport habits, while other explanatory variables such as gender, occupation, or individuals’ factors appraisal when making a trip, resulted non statistically significant. The modeling results also point out that those only individuals living in small cities might shift to a more sustainable transport mode (close to being significant).

Regarding mobility habits, the main statistically significant results concern car drivers. Individuals conducting leisure activities (regardless of their frequency) and using the private car for this trip purpose present a lower willingness to shift to more sustainable modes. This result is also the case of those respondents using their car occasionally for shopping activities (p-value = 0.026), while results in case of frequent use for children/elder assistance is close to being statistically significant (p-value = 0.068). In line with previous models, these results indicate the higher inelasticity of car drivers when conducting non-commuting trips. In the same line, the intensive use of “other modes” (mainly including taxi, ride-hailing, and carsharing) for shopping purposes provided a negative, statistically significant coefficient (p-value = 0.049). Again, this reflects the car prone attitude of some people for non-commuting trips.

Surprisingly, commuting mobility did not provide statistically significant results for any transport mode. Concerning the rest of the transport modes, the only noticeable result is the negative coefficient obtained for those people occasionally conducting assistance activities and traveling on foot. The coefficient is close to being significant (p-value = 0.058) and reflects the fact that, for those people already traveling on foot, it is not possible to shift to a more sustainable transport mode.

4. Conclusions and policy implications

Given the results presented in this paper, we can draw some conclusions that may raise some implications regarding transport policies after the COVID-19 pandemic in Spain.

Surprisingly, the degree of commitment to the three types of transport policy options, namely new car restrictions, more pedestrian space, and switch to more sustainable mobility, is higher compared to what would be observed under normal circumstances. We should point out that proposing measures generically rather than providing specific characteristics make measures more abstract and, consequently, more easily acceptable to respondents. Nevertheless, results are somewhat surprising, given that in recent years attempts to implement measures aimed at improving sustainable mobility generated controversy in almost every Spanish municipality. However, the adoption of some NPIs arising from the pandemic, especially the need to keep physical distance between people, is presented as an opportunity to rethink our cities through new urbanism approaches at the service of new needs. Since the research foresees a general reduction in public transport use, more individuals will use public space to move around individually. In that sense, and given that public space is limited, there is a struggle over whom to prioritize. Therefore, the historical moment we live in might be used to prioritize individual sustainable modes, mainly soft modes.

As seems evident, the strong support observed for limiting car use and increasing space devoted to soft modes has important implications for the redistribution of public space. Since public space is limited, it should be allocated to the most sustainable modes at the expense of car use. The overview presented by this research shows that the lockdown time drove a collective reflection on the suitability of the current distribution of public space since mobility at that time was generally restricted for a few activities into the closest area. Similarly, there was also a massive support to using more sustainable modes if the lethality and the possibility of COVID-19 contagion were higher in cities with more polluted air. These results show that, under these circumstances, a window of opportunity is opened for change towards more sustainable mobility by, e.g., reducing the space for the car, given that part of these would shift to alternative motorized options such as public transport. This situation requires redefining public space with new criteria to provide comfort and safety for soft modes, especially for pedestrian mobility. In the case of Spanish cities, this does require searching for innovative design, but a return to the urban design of the traditional Mediterranean city. However, given the pace of city production in recent decades, this implies the need to resolve the contradiction between traditional urban areas (dense and walkable) and more recent urban developments (low density and car-dependent designs).

Since no data has been collected in the questionnaire regarding respondents’ household location, this research could not explore to what extent individuals’ level of support towards these measures are influenced by residential location and neighborhood characteristics. It would be interesting to explore whether the support for the measures is higher among those who live in central areas of the city where they can make their daily trips walking or by bicycle. We should remind that support for all three measures is broad. Nevertheless, not all individuals might support them to the same grade. Therefore, we could say that there are “large promoters” and “small promoters” but none group could be considered as “detractors”.

For example, support for car use restriction is lower among people with monthly incomes over €3000 and among respondents who use the car intensively both for commuting and for shopping. By contrast, individuals with higher support to the measure generally use soft modes intensively (particularly cyclists compared to pedestrians). This support pattern also occurs when proposing the increase of pedestrian space at the expense of car space. Thus, the restrictive measures designed should seek maximum support among the latter, but without losing sight of the need to consider the conditioning factors of the former. For example, in case people with high incomes live in gated communities, it would be necessary to seek mobility alternatives that allow them to use the car for part of their journey to reach a public transport station, even if its use is restricted so that they can make their full journey.

These results require in-depth analyses of the structure of urban areas, which could lead to establishing new channels of participation that would change current practices on mobility governance. This new governance aims to establish partnerships that allow both the promoters of the measures and the citizens to participate in the decisions. Similarly, participation mechanisms must allow people that either have doubts about the effects of the measures or are against them to express their opinion. Involving these people in the decision-making process is a way of turning them into promoters, thus avoiding an increase in the number of detractors.

Regarding individuals’ willingness to choose a more sustainable transport mode based on the effect of the spread and lethality of COVID-19, it is striking that pedestrians, cyclists, and public transport users would be the most likely to consider using more sustainable modes. This result is a reaffirmation of their own previous choice. The geographical analysis shows no differences across metropolitan area size in terms of
restricting car use. However, the modal shift towards more sustainable modes might be more prevalent in small and medium-sized cities, with a predominance of soft modes, consistent with greater support for increasing pedestrian space as the size of the city decreases.

A possible proposal to address all sensitivities and not to compromise resources is adopting tactical urbanism as a working methodology. This strategy consists of implementing agile designs with, quick and straightforward actions to be implemented and, at the same time, cheap since they require the minimum intervention of work.

Depending on the degree of commitment and the Public Administrations’ willingness, the citizens can also be co-designers of the new public space. However, in every case, it is suggested to incorporate the citizenry in the monitoring process to keep the self-implication on every measure. If the mobility system’s response and the users’ acceptance is adequate, work that consolidates the intervention can be carried out. If the response is not adequate, the implementation may be reversed, and a new configuration of the public space can be proposed (and a new follow-up process initiated). We recommend this as an evaluation process for the redistribution and implementation of public space. That is to say, this methodology enables the participation of both, promoters and detractors, during the process up to the final result, by not compromising many resources. Likewise, it is a philosophy that incorporates the idea that public space can evolve according to citizens’ needs. This philosophy is why tactical urban design is essential, as it reduces the costs of errors to a minimum and allows a fast implementation to obtain successful results.

In this way, we identified a twofold opportunity for change in the crisis, in the way people move and, in the emergence and consolidation of a new form of urban governance. In this emerging transition, and given that support is now massive, the opportunity must be seized by adapting the cities to the needs arising from the COVID-19 pandemic and also boosting the changes needed to mitigate the effects (climate change, inequity, and the impending economic crisis) of our unsustainable mobility habits. We must take advantage of the opportunity that the current situation offers us because our survival is at stake, and important changes can be carried out.

It is necessary to mention that this research has some limitations, which may open future research questions. The responses may highly be conditioned by recent traumatic experiences and the high degree of socioeconomic uncertainty in the post-COVID-19 period. Therefore, it is necessary to take the results of this paper with adequate caution. In this sense, it is necessary to make it clear that the interaction through a survey would be completed through other mobility data sources and more exhaustive future surveys, which must include a broader sample or better residential description among others. It is difficult to discern with complete certainty whether the results in favor of the three options are a reflection of a previous idea that crystallizes, accelerating the process of consolidation of new urban values due to the situation experienced or if, on the contrary, it is the shock produced by the pandemic that produces this change in values. To mitigate this effect, the survey questions explicitly mentioned COVID-19 to clarify to those surveyed that the intention was to assess changes motivated explicitly by the situation arising from COVID-19 pandemic. When the final version of this manuscript was submitted, Spain’s situation was still unstable, and this proposed future research was still not possible. Only similar exploratory studies would be undertaken. Additionally, Spain is a diverse country, and the acceptability of studied measures might vary geographically and on the housing type, among others. These differences would be depth-analyzed in future research.

This paper’s results might also be used to raise some proposals to mobility policies’ and rethinking urban public spaces in other similar regions and countries, such as Italy (either by the socioeconomic structure or the impact of COVID-19 in their societies), but understanding them in their reality.

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Author contributions

RJ, BM-G: Introduction. SA-N: Data analysis. JG: Binary Logit model. All: Model interpretation and conclusions. All: Survey preparation. SA-N: Coordination.

Declaration of competing interest

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Appendix A. Supplementary data

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