



Understanding public transit travel choice in the post COVID-19 era: Policy implications

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This brief highlights the value of understanding public transit travel choice in the post-pandemic era as part of the recovery and future development of urban public transit systems. Salient factors influencing citizens' public transit travel behaviour are identified, and the decision-making mechanism behind the apparent decline in ridership is revealed using a micro-behavioural framework. Suggestions for policymakers are provided based on said analysis.

Background

Public transit is essential to alleviating congestion and reducing carbon emissions in cities. As one of the most dynamic public amenities, it plays a vital role in stimulating the urban economy and providing affordable mobility for inhabitants. However, the coronavirus pandemic has had severe negative effects on public transit systems worldwide. According to Google's 'Community Mobility Reports,' the drop in activity levels for public transit hubs during lockdown periods was 50% to 85% in the world's major economies. Evidence also suggests that the impact of COVID-19 on mobility behaviour is lasting into the post-lockdown period. At least for the time being, the pandemic has put past efforts to prioritise public transit in jeopardy.

Since the outbreak of COVID-19, actions have been taken worldwide to strike a balance between social distancing and public transit mobility. Reports and studies concerning public transport planning have often analysed the various non-medical interventions, such as decreasing the maximum number of allowed occupancy or hours of operation and their impact on mass transit systems at different population levels. However, the role of the individual as an active and creative agent should not be overlooked. As many economies now head towards recovery from this unprecedented crisis, understanding personal travel choice could not be more important to policymakers.

This brief uncovers individuals' post-pandemic public transit travel choice-making processes, and provides suggestions for short- and long-term policies to promote public transit by looking at Beijing. Beijing has a large-scale public transit system consisting of buses (including trolley buses) and rail transit (light rail and subway). The system is an essential component of the urban transportation system. Beijing is also a typical post-pandemic city: after the first wave of the pandemic (January and February 2020), public transit ridership gradually increased from around 20% to around 80% of that of the previous year. Therefore, Beijing is an ideal case for analysing individual mobility behaviour changes and policy implications.

Key message

The COVID-19 pandemic has affected individual people's public transit travel behaviours. As social and economic activities have gradually resumed normality, understanding individual travel behaviour is vital to public transportation planning in the post-pandemic era. **For policymakers, in the short run, public transit promotion should target citizens' 'attitude' and 'subjective norm,' as the psychological risk from anxiety of the perceived danger of public transit use may be a major barrier to recovery. This negative effect can be offset by improving knowledge of the real risk. In the long run, travel habit formation is essential to the continued development of public transit systems.**

What are the general patterns of changes that have taken place in the public transit system since the COVID-19 outbreak?

It is important to examine the changes public transit systems have undergone since the outbreak of the pandemic in January 2020. Our study uses data from Google's 'Community Mobility Reports' to describe worldwide trends, and data from Ministry of Transport of the People's Republic of China (PRC) combined with data from National Health Commission of the PRC and Beijing Municipal Health Commission, to depict transit ridership changes against the course of the pandemic in Beijing.

distance, causing transport modal split to shift away from public transit. In many countries, regular passengers of public transit turned to walking, cycling, or using private vehicles. Risk perception is frequently mentioned in the existing literature. On the one hand, compared with other modes, there was a higher level of psychological risk associated with public transit during the pandemic. On the other, varying tolerance levels for risk among individuals may affect reluctance to take public transit.

The V-curve/W-curve of public transit activity levels.

Against the background of government restrictions and widespread travel anxiety stemming from the COVID-19 pandemic, public transit modes were among the most affected forms of urban transportation. People avoided public vehicles to socially

The trends of public transport activity measured by public transport hub usage in many important economies appears to form V-shaped or W-shaped curves (Figure 1). In many countries, the first wave of the pandemic caused a dramatic drop in public transit hub activity level in March or April 2020. Then, activity levels began to rise gradually until September or October 2020. Towards the end of 2020, activity levels experienced another rapid fall.

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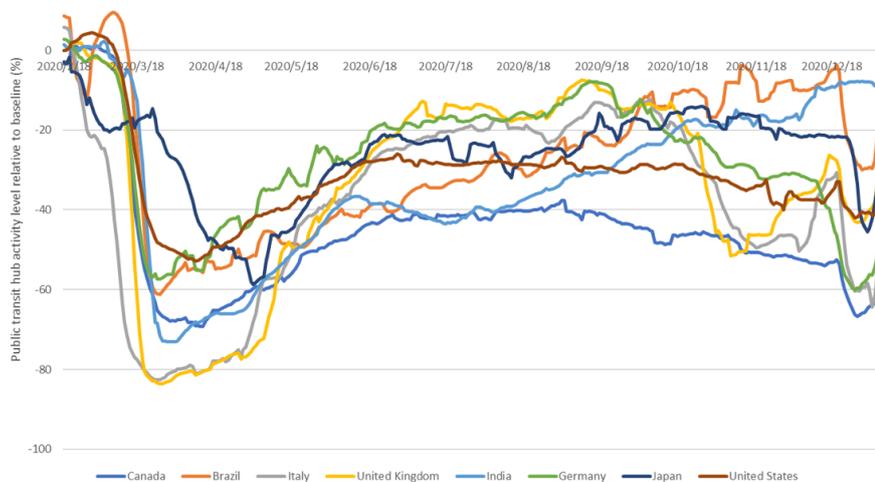


Figure 1. Public transit hub activity level change (7-day moving average between February 25, 2020 and January 12, 2021 for 8 countries)

Beijing's public transit ridership changes with the course of national and local pandemic spread.

Beijing's public transit ridership bottomed out at 80% pre-pandemic level in February 2020, then increased and stabilised at 20% pre-pandemic level before another drop in January 2021.

Like most cities around the world, Beijing's public transit system has been hit hard by the COVID-19 outbreak. Figure 2 shows the negative effect of the pandemic on both bus and rail transit ridership. On a national scale, the first confirmed case was reported in December 2019. In February, more cases were revealed as the result of large-scale tests. However, since March 2020, the number of new cases has decreased. Although there have been fluctuations, the incidence rate of COVID-19 has mostly levelled off.

February 2020 in Beijing. In the meantime, ridership of buses and rail transit decreased by 77.9% and 88.7%, respectively. Then, ridership increased despite a smaller wave in March 2020 due to increased imported cases from abroad. As of May, ridership rose to around half of that of the previous year, before being interrupted by a third wave in June due to a cluster of infections that emerged in Xin Fa Di Market. After that, Beijing entered a five-month low-risk period until a small number of confirmed cases was reported in late December 2020 and January 2021. Transit ridership continued to increase in August and September as the city moved on from the pandemic. Beijing's public transit ridership bottomed out at 80% pre-pandemic level in February 2020, then increased and stabilised at 20% pre-pandemic level before another drop in January 2021.

In line with national trends, the first wave of the pandemic occurred in January and

New Confirmed cases: nationwide/Beijing (cases, 5-day moving average)

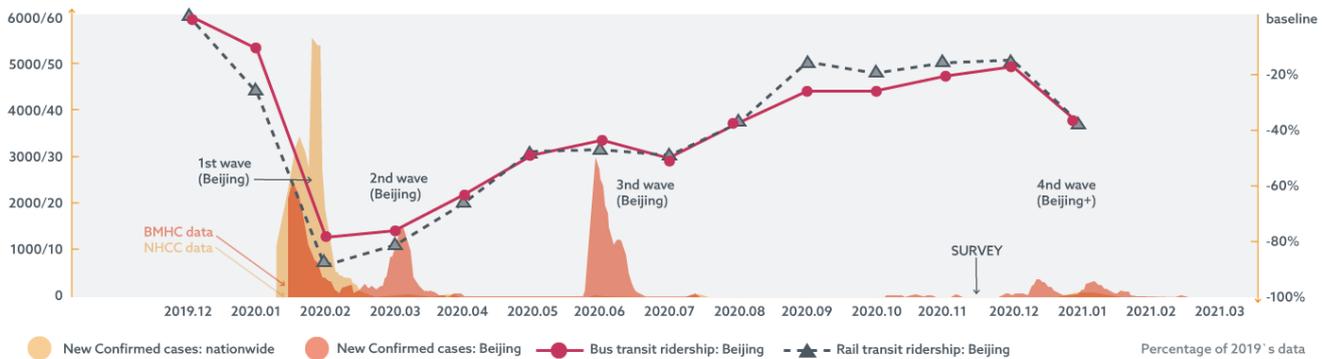


Figure 2. The course of the COVID-19 pandemic and public transit ridership in Beijing

From November 27 to 30, 2020, an intensive online surveying campaign took place. A period including a weekend was chosen to increase the participation rate. This period was ideal for reflecting people's attitudinal and behavioural states in the new post-COVID-19 normal because it came after a

four-month low-infection period and before the rise of confirmed cases in December (Figure 2). Public transit ridership has largely recovered, and the pace of life has returned to normal, although COVID-19-preventive measures are still in place.

What does individuals' post-pandemic public transit travel choice-making mechanism look like?

The micro-behavioural framework.

Our research is guided by the Theory of Planned Behaviour (TPB). According to TPB, the volitional factors (attitudes and subjective norm) and the nonvolitional factor (perceived behavioural control, or PBC) are the proximal determinants of intention. Furthermore, intention and PBC act as the direct predictors of actual behaviour.

Attitudes toward using public transit indicate how positively or negatively the individual perceives the use of public transit in the post-pandemic era. **Subjective norm** captures the individual's perceived social pressure to use public transit. **Perceived behavioural control** relates to the individual's evaluation of the ease or difficulty in using public transit. **Intention** represents the individual's transit use motivation, and **behaviour** represents

actual use of transit.

The original TPB framework is improved by taking into account the nature of the post-pandemic context and the nature of mobility behaviour. In this pursuit, three new model constructs are incorporated to the TPB framework: 1) perceived knowledge of COVID-19; 2) psychological risk of COVID-19; and 3) travel habit. **Perceived knowledge** represents the individual's awareness of the facts about COVID-19 and the possible outcomes of public transit use in the post-pandemic era. **Psychological risk** refers to feelings of mental discomfort or anxiety caused by traveling in a public vehicle; it reflects the negative effect of the pandemic on citizens' peace of mind. **Travel habit** is people's usual pattern of travel, a behavioural script that they tend to follow in a stable environment.

Figure 3 summarises the research framework.

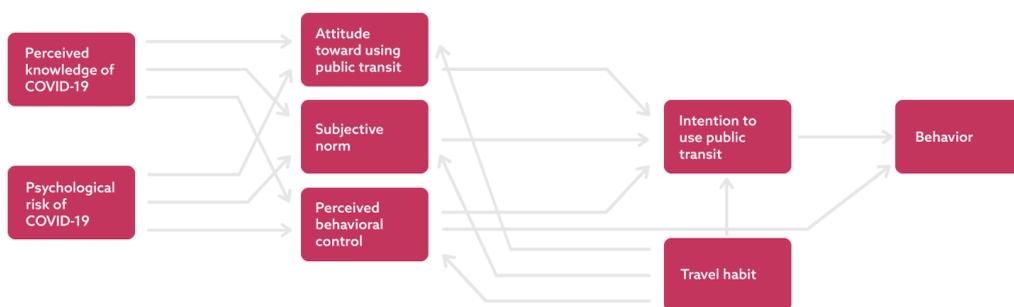


Figure 3. An extended micro-behavioural framework to explain the individual's post-pandemic public transit travel choice

In terms of the recovery of urban mass transit systems and public order in the post-pandemic era, higher perceived knowledge of COVID-19 is a potential booster, while higher psychological risk of COVID-19 is a barrier.

Individual's transit use habit is an important predictor of transit use decision, even after the interference of a global pandemic.

Assessing the effects of important behavioural factors on citizens' post-pandemic public transit use.

Structural equation modelling is used to determine the model. Figure 4 summarises our results. The key findings are threefold. First, volitional factors (attitude and subjective norm) play a more important role than nonvolitional control (perceived behavioural

control) in the individual's post-pandemic public transit travel choice-making process. Second, in terms of the recovery of urban mass transit systems and public order in the post-pandemic era, higher perceived knowledge of COVID-19 is a potential booster, while higher psychological risk of COVID-19 is a barrier. Third, the individual's transit use habit is an important predictor of transit use decision, even after the interference of a global pandemic.

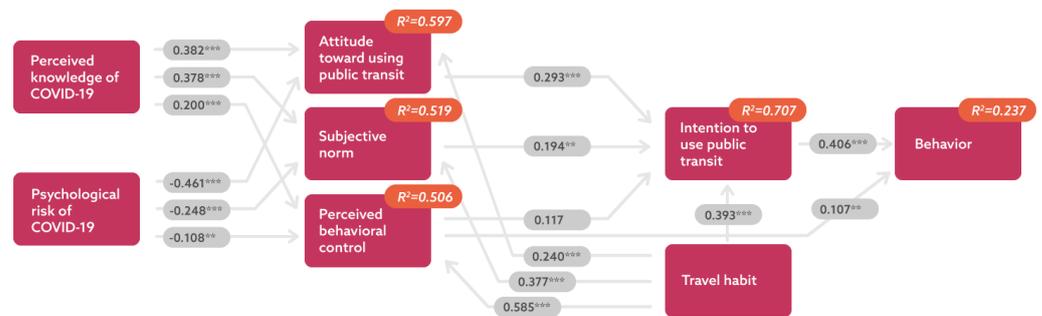


Figure 4. The decision-making process of the individual concerning public transit use in the post-pandemic context

How can policymakers promote public transit modes and recover public transit systems in the post-pandemic context?

Personal attitude to public transit is the most important direct predictor of transit use intention

Short-term policy implications.

Among the original TPB constructs, personal attitude to public transit is the most important direct predictor of transit use intention followed by subjective norm, while perceived behavioural control does not have a significant effect on transit use intention.

This brief identifies influential cognitive factors for people's post-pandemic public transit use intention and behaviour: attitude and subjective norm. Appropriate policies aimed at changing these factors are able to produce effects in the short term. Ways to create more positive **attitudes** include lowering prices, offering free rides during rush hour, and improving service quality. To influence **social**

norm, policymakers could conduct mass media campaigns to encourage public transit use.

We also suggest that a **higher level of perceived knowledge of COVID-19 is a positive influence on people's public transit use** intention in the post-pandemic context, while the **higher psychological risk of COVID-19 is a negative influence**. To reduce psychological risk (PR) and limit its negative effects, useful measures include the requirement of mask-wearing, regular disinfection of public vehicles, and offering customised public transit services.

In Beijing, customised public transit services, in effect since February 2020, have likely contributed to ridership growth. For bus transit, citizens can enter their travel schedule and original destination information via a mobile phone app, and a customised bus line would start operation when the number of requests reached a certain threshold. This program has reduced close-contact rates and passenger flow levels in regular bus stations during peak hours; thus, it may be helpful in lowering people's PR while generating benefits from low-carbon emissions of public transport. Customised bus rapid transit lines were also set up for workers of the same companies, groups of tourists with similar destinations, etc. For perceived knowledge, it is important to make sure that once a low-risk post-pandemic environment is achieved, people are well informed of the small possibility of infection on a public vehicle, so that they are not overly afraid to take public transit.

Long-term policy implications.

The habit of travelling by public transit has a long-term impact on people's public transit mode choice-making mechanism even when an outbreak event, such as COVID-19, intervenes in their intention and, thus, behaviour. In terms of total effect, travel habit is more important than attitude, subjective norm, perceived behavioural control, perceived knowledge, and psychological

risk of COVID-19 in predicting intention and behaviour. Therefore, long-term policies aimed at promoting public transit should focus on public transit travel habit formation.

It is evident that the COVID-19 pandemic has brought tremendous changes to individual behaviours, from economic development to personal lifestyles. Therefore, the pandemic could have changed people's mobility habits, and this post-pandemic habit could change future trends of public transit ridership and system development. Decision-makers should keep in mind how these transit travel habits have been altered, how this change could influence the public transportation system, and in what ways this trend could be reversed in the long run.

This report is based on research publications submitted to journals for peer review.

Copies of academic outputs relating to this research can be obtained by emailing the corresponding author: Pengjun Zhao

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Long-term policies aimed at promoting public transit should focus on public transit travel habit formation.

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2. Fostering the next generation of leaders that draw on different perspectives and backgrounds to address the greatest urban challenges of the 21st century;
3. Growing the capacity of cities to understand and plan their own futures;

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Third, **Adoption** signals to the choices made by states, citizens and companies, given the specificities of their places, its resources and the interplay of urban dynamics resulting in changing local power and influence dynamics.

Finally, the **Knowledge** component accounts for the way in which knowledge is exchanged or shared and how it shapes the future of the city.

PEAK Urban is funded by UK Research and Innovation as part of the Global Challenges Research Fund.



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