Reflections on City Planning and Transportation System under the Normalization of COVID-19 Pandemic Based on Network Survey in the Era of Big Data

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Abstract. In order to analyze the impact of COVID-19 on urban transportation and provide policy recommendations for city and transportation planning and management under the normalization of the pandemic, this article conducted an online survey to examine urban mobility change in Beijing. Combined with the current status of transportation operations, this article studied the opportunities and challenges faced by future urban transportation planning, construction and management. The results show that the travel numbers declined during the pandemic and people prefer to travel by cars and bicycles. In the end, this article put forward reflections on city planning and transportation system including creating an efficient life and commuting circle, reshaping the street space to be more friendly for active mobility, building the on-demand and resilient transportation system and promoting the integration of advanced technologies and traffic governance to enhance the resilience of transports system and achieve the smooth operation of urban transportation.

Keywords: COVID-19, Urban Mobility, City Planning, Resilient Transportation, Beijing

The COVID-19 pandemic has brought an extraordinary impact on the city operation. According to the official notification of the National Health Commission, as of 24:00 on December 31, 2020, 31 provinces and the Xinjiang Production and Construction Corps had reported a total of 87,071 confirmed cases. Given characteristics of the COVID-19 which has continuous human-to-human transmission and strong infectivity during the incubation period, the infection prevention and control of the pandemic will be normalized in the next few years. Under the normalization of the pandemic, how cities and transportation operate to efficiently meet the travel demands of enterprises and residents have become the most pressing issues in major cities at home and abroad. Taking Beijing as an example, this article analyzed the challenges brought by the pandemic to urban transportation and key measures introduced to respond to the pandemic. The urban mobility under the pandemic has been deeply examined and some reflections on the urban space reshaping and transportation system

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planning has been put forward to enhance the resilience of transports system and achieve the smooth operation of urban transportation.

1 Urban Transportation during the Pandemic in Beijing

The mass migration of people is becoming an important part for the rapid spread of diseases. Transport is regarded as an important link in prevention and control of the pandemic [1]. Since January 2020, Beijing has taken active and effective responses to prevent and control the spread of COVID-19, including suspension of the inter-provincial passenger transport and the full load rate control of public transit. Strict control measures brought profound impact on urban transport. In the early stage of the outbreak, the total trip number in Beijing was reduced to around 20% of last year’s total trips and after four months, the trip number has yet to fully recover [2].

As the spread of local epidemic has been basically blocked, the proportion of resumption of work and production has gradually increased. Beijing insists on the parallel response to epidemic prevention and urban operation guarantee. From the public transit aspect, about 200 on-demand buses are in service and over five subway lines optimized the running diagram to alleviate the congestion in the carriage. The subway reservation services are also piloted to help prevent and control the epidemic. In order to prevent the virus spread through public transit, Beijing suspended the limit of motor vehicle tail number. While, encouraging green and low-carbon travel modes is still the basic logic of the sustainable development of urban transportation [3].

2 Urban Mobility Change in Beijing during the Pandemic

The pandemic led to a significant reduction in the travel demand and change in mode structure [4]. In order to examine the mobility changes in Beijing, we conducted an online survey from April 28 to 30, 2020. 2398 valid questionnaires are collected. The results show that the trip number has dropped sharply during the pandemic. Trips using shared bicycles and privately owned cars has increased significantly.

2.1 Trip Number Dropped Sharply

Before the pandemic, people traveled an average of 2.67 times per day during the working day, while it dropped to 2.1 during the pandemic. After the outbreak of the pandemic, 85.2% of the people had less than 3 trips/day. The proportion of people travelling over 4 times has dropped sharply. People have actively reduced unnecessary trips during the pandemic. From the trip number change of car-owned and car-free groups, trip number of both groups has decreased significantly.

2.2 Travel Demand for Goods Pickup and Delivery Increased

During the pandemic, over 70% of people reduced trips for shopping and recreation. The online shopping number increased from 2.08 to 2.85 times per person a week. The top three shopping behaviors replaced by online shopping are shopping at the vegetable market, supermarket and the mall. In addition to the necessary trips to work, the largest increase in the trip number was goods pickups, which was related to the increase in online shopping and home delivery during the pandemic.

2.3 The Proportion of Trips Using Bicycles and Cars Has Increased

During the pandemic, the proportion of trips by cars, walking and bicycles has increased significantly. The proportion of commuting trips by car reached 40.7% with an increase of 7.1 percentage points compared to the number before the pandemic. Trips using privately owned bicycles and electric bicycles increased by 2.1 percentage points. Trips using dockless and docked shared bicycles increased by 0.3 percentage points. Trips of walking to and from work also increased by 0.9 percentage points. More than 3% of people purchased cars, bicycles and electric bicycles during the pandemic. The occupancy rate of taxis and privately owned cars has increased from 1.24 to 1.55 person/car [5]. It has become more common for families to travel together and carpool with others.
3 International Experience

3.1 More Supports on Travelling by Bikes and Walks
The preference to walk or cycle is expected to continue after the end of pandemic. Cities in the world provide solid supports like investing on cycling infrastructure and reshaping road space to encourage active mobility. Transport for London has put the network construction for active mobility on their top agenda which is considered as the start for a new mobility revolution [6]. The British government also devised 100 billion pounds for transport infrastructure projects. The protected bicycle lanes may be one of the projects [6]. With the continual increase of COVID-19 patients in Tokyo, 64% employers in Tokyo Metropolis allow bike commuters in May. Cities in Italy and United States implemented walking and cycling infrastructure upgrade during the pandemic. People travelling by bikes in New York increased by more than 20% [7].

3.2 Adjusting Bus Lines in A Targeted and Needed Way
During the pandemic, the travel is clearly distinguished into necessary and unnecessary one. For necessary trips, the bus line facilitating “point to point” travel should be planned. In many overseas cities, “telephone dispatching bus” or similar mobility service are increasingly accessible. Lowering of unnecessary bus line operation will also help energy saving and emission reduction. The official website of Scotland Parliament enables people accessible to customized bus reservation service. In Ontario, the bus operators replaced their bus line service with customized shuttle bus service based on big data analysis and timely adjusted the bus line as required [8].

3.3 Encouraging Car Commuters Carpooling with Families
The bus service faces greater challenges on more intensive, closed and higher contacts than the private vehicle during the pandemic, so the proportion of trips by cars increased during the pandemic. In March 2020, the Center for Disease Control and Prevention (CDC) launched an announcement to suggest enterprise to encourage employees commuting by private cars, walk or bikes. For car commuting, it advocates car driver to share car with families in order to relieve the risk of strangers contact infection [9]. With the pandemic becoming normal, more and more people resume to go to work in their office and they are worrying about sharp increase of cars and traffic jamming. Considering of limited parking space in the city, it is difficult to support everyone’s vehicle mobility and that’s why taxi and online ride-hailing have been an alternative mobility choice. For this reason, CDC also gives relevant suggestion on epidemic prevention for taxi and online ride-hailing drivers, including suggesting passengers taking back seat, drivers and passengers both wearing face mask, and reducing multiple passengers riding, etc. [9].

3.4 Shifting Peak Trips by Staggered Office Hours
Office buildings featuring large flow of people and relatively closed space have been the focus of pandemic prevention and control. For eliminating cross infection of people in office buildings, CDC encourages enterprise to allow employees staggered office hours and flexible working hours so people could take bus in off peak hours and lower infection risks and minimizing persons in the office at the same time [9].

Since the outbreak of the pandemic, the percentage of telecommuters in US has highly increased. Investigation of Professor Brynjolfsson research team from MIT in April 2020 reveals there are 14.6% telecommuters before the pandemic, but another 34.1% people have started telecommuting. That means after the global pandemic outbreak, the telecommuters in US has almost reaching up to 50% [10]. The increasing proportion of telecommuting will effectively help minimize people’s travel demands and lower the infection risks when taking public transit and working in the office.

4 Reflections on City Planning and Transportation System
4.1 Building the Efficient Life and Commuting Circle
In the context of constantly external expansion of city, highly concentrated jobs distribution and inter-region commuters are quite normal, leading to the dominant mobility by bus and rail transit, which greatly challenges the pandemic prevention and control. In order to effectively prevent and control the spread of the pandemic, major cities around the world have re-emphasized the requirements for the construction of a 15min or a 5min living circle. Paris has continuously emphasized the importance of a 15min urban living circle and promoted the construction of compact cities[11].

The mobility structure of a city will be impacted by the functional planning and city layout to a large extent. At the regional level, it should build a mixed-function area to make houses closer to jobs to effectively optimize urban space layout and minimize the inter-region and long-distance commuting. From the perspective of community function, building the 15min community living circle to make people accessible to various life services in an easy within 15min’ walk. This will be highly helpful for reducing inter-region trips and cross infection risks among people. Under an efficient living and commuting circle, the mobility mode of people will change accordingly. In the 15min living circle, most short trips for people’s basic living needs could be met by bike or walk. For long distance commuting trips, people can take regular buses, on-demand shuttle buses and rail transit. The construction of a well arranged, healthy and resilient transportation system will effectively meet different mobility needs of people and improve capability of city and transportation system coping with risks.

4.2 Reshaping the Street Space and Encouraging Individualized Green Mobility
After the outbreak of the pandemic, bike has been the most popular mode choice of people except private cars. Green mobility including walking and cycling booms across the world. People in New York, Tokyo, Copenhagen or similar cities start commuting by bikes. The urban transportation planning should take this chance to reshape the urban street space to create better environment for green mobility and make the travel habits continue. The change of people’s mobility habit is mainly affected by two forces, one is binding force, such as increase of car parking fee, jamming fee to limit the usage of private vehicles. The other one is incentive force, like the provision of excellent environment for active mobility. Combined with prevalent problems of walking and cycling infrastructure in current transportation system, the construction of relevant facilities and reshaping of street space will be critical to help transfer mode choice. In one hand, the concept of vehicle-oriented transportation must be changed to human oriented so that the optimized street space will be more supportive for active mobility. On the other hand, we need to continually improve the supporting facilities for active mobility to create a continual, complete and independent walking and cycling system. This will help minimize conflicts among various activities and provide high quality and safe environment for active mobility, which will help mobility transfer to a greener one.

4.3 Building Demand Responsive and Resilient Transport System
The daily operation of a city will be impacted and disturbed by many external factors [12]. It is expectable more emergency events like COVID-19 will emerge and the urban transport system must improve its resilience against risks. The core is to respond to uncertainty arousing from external impact and disturbance and minimize adverse influence on urban transportation. With China’s pandemic prevention and control normalizing, transportation system is facing a complex challenge of gradually increased mobility needs and rigid demand flow on a substantial scale along with the work and production resumption. During the pandemic, people’s mobility mode has been substantially changed. They actively minimized unnecessary trips. With the telecommuting prevailing, traditional large scale and concentrated commuting demand is seen with contraction to a certain extent. The travel demand shows a scattered and flattened characteristic. Under this context, the fixed stop and fixed line with high frequency supply mode will be neither economic effective nor efficient that makes the building of a demand responsive and resilient transport system necessary. Especially in public transit, the reliable and flexible transport supply is facing the critical breakthrough. During the pandemic,
cities including Beijing, Shenzhen, Chongqing and Chengdu all launched the customized bus line to enable people book the bus online with one person one seat and enjoy the rapid and direct commuting service. This service effectively solves the traditional traveling difficulties on control of passenger quantity, passenger tracking and provides public a safe and reliable travel support and meets the mobility needs for work and production resumption [3].

4.4 Boosting Deep Integration between Big Data and Transport Management

Big data has played a critical role in providing solid support for the pandemic prevention and control. The E-commerce and similar business also achieve impressive results. In the future, the deep integration between big data and transport management are expected and big data based granular urban transport management will be gradually implemented in all stages of urban transport planning, construction and management. The big data may be applied in two aspects of transport management in the future. Firstly, it can help support to make emergency transport decision and effectively track people flow, real-time logistical distribution and improve capability of urban transportation system coping with risks by boosting mobile signal data, GPS location data and other big data from multiple sources. Secondly, through efforts on boosting deep integration of advanced technology with transport control, the intelligent decision-making system will play a significant role in identifying urban transportation problems and giving relevant solutions.

5 Conclusions

This article examined mobility changes by an online survey during the pandemic. People prefer bicycles and cars for necessary travel. We should seize this opportunity to create an efficient living circle. Through reshaping the street space, our city will create a good environment for walking and cycling. Through building an on-demand and resilient transportation system, the ability of our city and transportation to risks will be highly improved. It is also necessary to further promote the integration of big data and transportation governance throughout all stages of urban transportation planning, construction and management.

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