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Utilization Rate of Bus-only Lanes on the Main Roads in Beijing

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ABSTRACT: Fast and convenient transportation is one of the most important factors of a livable city. However, the problem of Beijing's traffic congestion has not been relieved. This study analyzes the utilization rate of bus-only lanes through field data collection and provides a reference for improving Beijing traffic planning and urban management.

Nine sampling locations with high cross-sectional passenger flow were selected for the study. Results show that the utilization rates of bus-only lanes in Beijing vary, but the majority are very low. Most bus lanes are underutilized in the morning and evening rush hours. Fushi Road, Wanquanhe Road, and the Third Ring Road have low utilization rates. The number of people passing through the social vehicle lanes exceeds those passing through the bus-only lanes. The bus-only lane utilization rates of the G4 and G6 Expressways are high during rush hours; the number of people passing through the bus-only lanes is higher than that of the social vehicle lanes. However, the total number of people passing through the G4 Expressway during the restricted hours is lower than that during the nonrestricted hours, indicating that the overall efficiency of the road is affected because of the opening of the bus-only lane.

KEYWORDS: Bus-only Lane; Utilization rate; Public transportation; Beijing city planning, Rush hour commuting.

Introduction

Bus-only lanes allow only public transport vehicles and special vehicles (such as ambulances and police cars on official duty) to pass during a specified time.[1] Other vehicles passing through these lanes at specified times are fined. Beijing is the first city in China to set up bus lanes. In 1997, the first bus lane in China was put into operation on Chang'an Avenue. As shown in Figure 1, Beijing's bus lanes are divided into three types: rush-hour bus lanes (a lane used by buses only during rush hours of the day and prohibited for social vehicles, except special vehicles), long-time bus lanes (a lane used by buses for consecutive times of the day when social vehicles, except special vehicles, are prohibited), and all-time bus lane (a lane used all day by buses and prohibited for social vehicles, except special vehicles).

Figure 1: Three types of bus lanes in Beijing: (a) rush hour bus lane; (b) long-time bus lane, and (c) all-time bus lane

In China, Buses and special vehicles mentioned above are non-social vehicles. Other vehicles, such as private cars and enterprise-owned vehicles, are social vehicles.

Since 2006, Beijing has developed public transportation by prioritizing public transport services. The number of bus lines and vehicles in Beijing is among the largest in the world. By the end of 2019, Beijing had 490 public transportation routes (including subways) and 37-night bus lines, with an average daily passenger flow of 60,000.

Beijing's road congestion remains critical, and the "capital" has become the "first congestion" (in Chinese, "capital" and "first congestion" have some pronunciation). Currently, the number of cars in Beijing is more than 6 million. Beijing established the subway system to relieve the road traffic pressure. The operating mileage of Beijing's subway system increased from 54 km in 2000 to 699.3 km in 2019. The annual passenger volume increased from 429 million to 3.96 billion in 2019 (before COVID-19) and 2.35 billion in 2021. Beijing's subway system has become the new backbone of Beijing's transportation. The passenger volume of ground buses decreased from 3.632 billion in 2000 to 3.17 billion in 2019 because of the increase in the number of private cars and the surge in the number of subway passengers.[2] In this context, the role of bus lanes in relieving traffic has decreased.

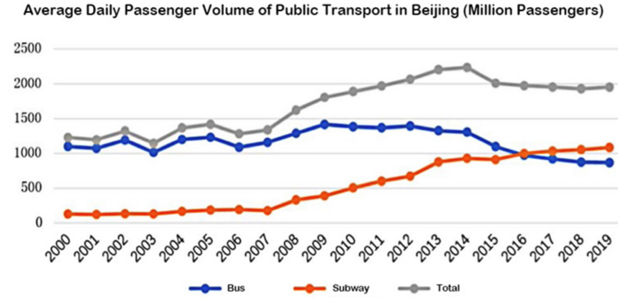

Figure 2: Change in the average daily public transportation volume in Beijing from 2000 to 2019[2].

Figure 2 shows that since 2015, the volume of public transportation passengers has gradually decreased, indicating that other modes of transportation, such as private cars and taxis, have started to play an essential role in urban commuting and transportation.

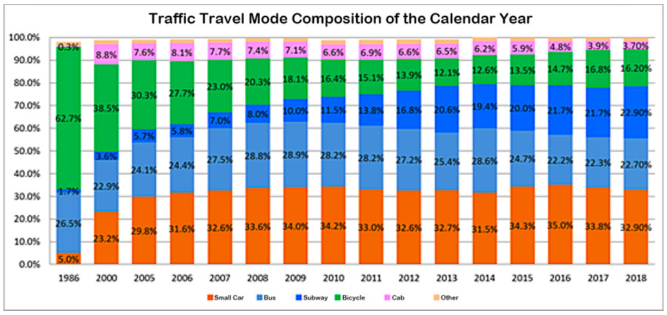

Figure 3: Composition of transportation modes in Beijing over the years.[2]

Figure 3 shows that the highest percentage of car trips was 32.9% in 2018, and the percentage of rail transportation surpassed that of road transit trips.

Most bus lanes in Beijing are rush hour bus lanes, which operate from 7 a.m. to 9 a.m. and from 5 p.m. to 7 p.m. for commuting. This initiative aims to alleviate the difficulties during the morning and evening rush hour travel. The use of public green travel has played a very good effect. However, the bus lane occupies part of the road space for social vehicles, separating buses from other social vehicles and making significant changes to the traffic operation of the road network. Observations show that the policy of limiting access during rush hours is still in place on weekends and holidays for bus-only lanes. However, this approach does not effectively utilize road resources and increases traffic congestion. The frequency of bus departures during the morning and evening trips on weekends and holidays is reduced compared to weekdays.

Moreover, the number of passengers is significantly reduced. Given that the holidays and weekends have no license plate restrictions for cars (policy of banning private vehicles from going on the road one day a week), many people who commute by public transport on weekdays mostly choose to drive cars during these unrestricted times to travel and visit friends. Thus, the number of vehicles running on the roads during holidays and weekends is greater than that during regular commuting hours, leading to severe road congestion. We can find that the overall utilization rate of bus lanes in Beijing is uneven. We observed that the bus lanes on the Fushi Road bus expressway and the Third Ring Road Expressway have been vacant for a long time, whereas the next two other lanes (social vehicle lanes) are crowded with cars. These cars were lined up in long queues, consuming much gasoline and emitting exhaust gases that pollute the air. The bus lanes are sporadic and cause other cars to merge back and forth, causing accidents and inconvenient driving.

Given such circumstances, the ground bus planning index of Beijing[2] indicated that the length and scale of bus lanes would be further increased to 1020 km in 2022. Increasing the number and length of surface bus lanes in Beijing's traffic under population defibering, the rapid increase of rail transit mileage, the large proportion of single-car trips, and the annual decrease of passenger capacity is doubted as being the correct thing to do.

As Beijing City's traffic condition worsens, bus lanes must be improved and replanned to reduce or solve congestion problems and make commuting to and from work efficient for Beijing residents. This study investigated the situation of bus lanes in some major cities with high population density in China and abroad to learn from domestic and international experiences. The installation and operation of bus-only lanes in some cities in China and abroad were investigated and described below.

HOV Lane (high occupancy vehicle lane) is a lane only used by vehicles, including buses, cars, or trucks with more than two passengers. Since 2014, Wuxi, Jinan, Shenzhen, and Chengdu have started to use HOV lanes to alleviate urban congestion. Shenzhen proposes establishing an integrated urban public transport service network with rail transit as the backbone, buses as the network, private cars as a supplement, and nonmotorized transport as an extension to ensure the reasonable use of road traffic resources by all modes of travel.[3] Nanjing and Shanghai both highlight the concept of bus priority. They proposed the regular optimization of the bus-only line network, integration and connection of rail transit and other modes of transport, preparation of special planning for bus-only lanes, and construction and optimization of bus-only lane systems, signs and markings, harbor-type stations, and electronic station signs. In addition to buses, vehicles with more than 20 passengers are allowed to use the bus-only lane in Shanghai. Hangzhou City allows buses, fire engines, ambulances, and other vehicles specified by the traffic management department to use the bus-only lane; the rest of the motor vehicles can use the bus-only lane during nonpeak hours or under the command of traffic police.

With 8.4 million people, New York is the most populous city in the U.S. The city government has faced a significant challenge in ensuring smooth traffic flow and convenient travel for its citizens. During a heavy traffic flow on the road, other vehicles are not allowed to occupy the bus lane without permission. Violators face hefty fines. In some major traffic lanes, vehicles other than buses are prohibited from turning left or right. The New York City government has also established HOV lanes to encourage private car owners to carpool to and from work. These lanes are only for vehicles with three or more passengers. If a car with less than three passengers uses this lane, a fine of $100 or more is imposed. Like the bus lanes, these lanes for vehicles with three or more passengers are designed to promote energy conservation and reduce traffic congestion on roads.[7]

Given the prevalence of highly developed cars in North America, 80% of vehicles on the road carry only one person, the driver, resulting in fuel wastage and environmental pollution. In Toronto and other cities in California, Nevada, and Utah, the innermost lane, called the carpool lane, helps solve traffic congestion. The sign for this lane is a diamond symbol. Implementing a carpool lane encouraged many commuters to carpool to and from work. The following vehicles are allowed to take the carpool lane: vehicles with two or more passengers; motorcycles; buses; hybrid vehicles; natural gas and clean-energy vehicles.

In the present study, field sampling and data analysis were conducted to investigate whether bus lanes in some main parts of Beijing have low utilization rates, which cause congestion and affect road access efficiency.

A literature search on the methods was conducted to analyze the efficiency of the bus-only lane and road utilization. Reference 8 proposed a method for calculating the efficiency of urban bus-only lane capacity using trip time, trip speed, cross-sectional passenger flow, passenger travel time savings, and bus lane utilization rate as efficiency indicators. A method for quantitatively evaluating bus-only lane efficiency using cell phone movement data was proposed in reference 9. The detection range was delineated on an electronic map and divided into bus-only lanes and other lanes. The ID numbers and location data of all cell phones within each detection range were obtained in real-time. The data of each cell phone was associated with the corresponding lane in the electronic map to obtain the number of people passing each lane and quantitatively evaluate the passing efficiency of bus lanes. The literature only proposes the method and does not provide specific application examples. Literature 10 used live bus data to obtain bus traffic in Pudong New Area.

Moreover, bus IC card swipe data were used to obtain bus passenger traffic and evaluate the peak of the one-way cross-sectional bus passenger traffic. Only the overall quantity statistics were obtained from bus live data. It was not detailed for each bus. It also locates each bus lane. Reference 11 used the Q-Paramics microscopic simulation model to demonstrate the Third Ring Expressway in southwest Beijing. The simulation results before and after the setting of the bus lane were quantified and analyzed.

In this study, the number of vehicles and passengers was collected separately from different types of bus-only lanes in different periods. The conclusions were drawn by comparing and analyzing the data through statistical methods.

Methods

Research Methodology:

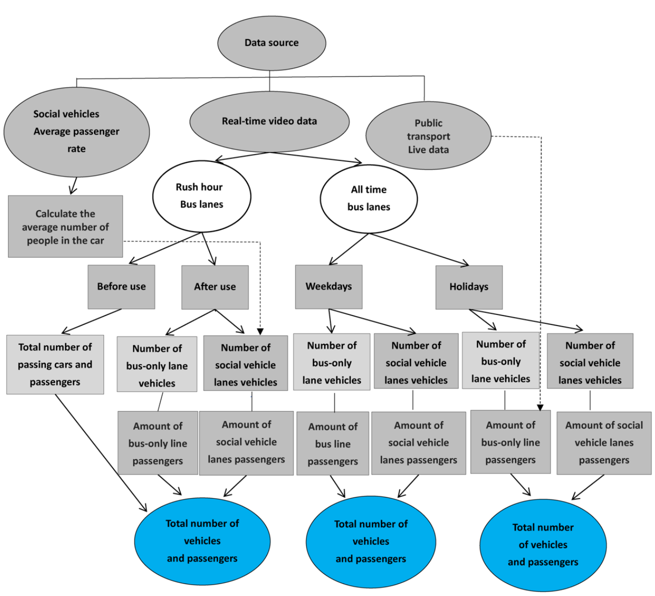

Figure 4: Workflow.

The flow of the research methodology is shown in Figure 4. The raw data include public transport live data, video data of field filming, and the average occupancy rate of social vehicles. The field filming sample is divided into rush-hour busways and all-day busways. For rush hour busways, we compared the number of vehicles and passengers in the bus-only lane and other lanes before and after the restricted time of busways. For the all-day busways, we compared the total number of passengers who passed on the busway during holidays and weekdays and the total number of passengers who passed on the social vehicle lanes to reach a conclusion.

Data sources

-Video data captured in the field:

Figure 5: Screenshot of the videos recorded on the Beishatan overpass

Cameras were set up in overpass bridges or tall buildings that could capture each lane separately. The acquired videos were used to count the number of vehicles passing through the bus and social vehicle lanes during the fixed period and obtain the bus serial number information (engraved on the back of the bus). The video screenshot is shown in Figure 5. The videos were acquired before and after the restricted time of the bus-only lane.

-Average passenger capacity of social vehicles:

We sat on a bus or stand by the roadside each day during rush hours to observe, record the number of passages in each car in the social vehicle lanes, and obtain the average passenger capacity of social vehicles. Then, we analyzed the statistical data to calculate the average passenger capacity of social vehicles through many records (at least 150 cars per person).

- Live data of buses:

The bus serial number can be interpreted according to the video recordings. We can query the bus's live data from the website https://bjbus.jinzihao.me/. GPS big data, bus IC card machine data, real-time location, route, occupancy rate (number of people), and bus speed are available. The number of passengers in each bus is added to obtain the total bus passenger flow during the statistical period. Figure 6(a) shows the live location of the buses, whereas Figure 6(b) shows the live data of the actual number of people on the buses from the website https://bjbus.jinzihao.me/.

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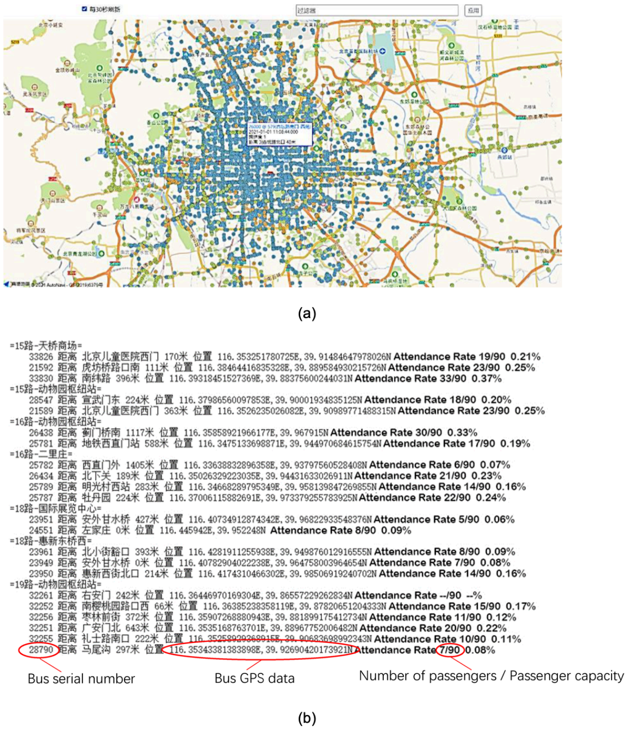

Figure 6: Website https://bjbus.jinzihao.me/; (a) live location of buses; (b) live feed of the people inside the buses.

Experimental design:

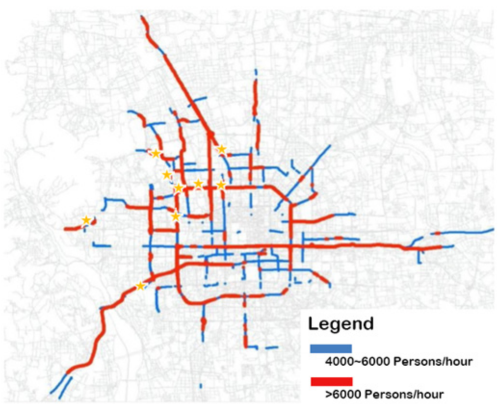

Figure 7: Distribution of surface public transportation; yellow five-pointed star is the sampling site. The numbers on the stars are the sequence of the sampling locations shown in Table 1.

-Sampling section and site selection:

Figure 7 shows the distribution of the public transportation's cross-sectional passenger flow surface during the morning peak in Beijing.[2] The red roads are the sections with sizeable public transport traffic. They mainly include the entire Third Ring Road, G6 Expressway, G4 Expressway, Beijing-Tongzhou Expressway, and some sections of Fushi Road. The locations with a high bus passenger flow were chosen for the sampling sites according to the passenger flow cross-sectional map. The reason is that the sections with a high bus passenger flow can fully reflect the issue of bus lane usage efficiency.

Moreover, they are highly representative. Nine representative sampling sites covering the main roads with bus-only lanes in Beijing were selected. The sampling locations cover different types of bus-only lanes and many bus routes. The details of the sampling sites are shown in Table 1.

Table 1: Sampling position

Sequence	Sampling locations	Types of bus lane
1	W.3rd ring road N. Huayuan overpass bridge	Rush hour bus lane
2	N.3rd ring road Dazhongsi overpass bridge	
3	N.3rd ring road Jimen overpass bridge	
4	N. 3rd ring road Sanyimiao overpass bridge	
5	G6 expressway Beishatan overpass bridge	
6	Wanquanhe road, xiyuan overpass bridge	
7	Wanquanhe road, Daoxiangyuan overpass bridge	
8	G4 expressway, lugou overpass bridge	
9	Fushi road, Jin yuan bridge, overpass bridge.	Full time bus lane

-Sampling time:

Different sampling times were designed for different types of bus lanes at the time of sampling to enable subsequent comparative analysis.

(1) Rush hour bus lanes: The sampling time was 5–10 minutes before or after the restrictions and another 5–10 minutes after the restrictions were implemented. For example, the restricted time is 7:00–9:00 a.m. The selected capturing times include 8:50–9:00 a.m. within the specified time and 9:00–9:10 a.m. shortly after the restriction ended. These sampling times were chosen because the time gap is small, and the traffic flow does not change much in these periods. The effect of the bus lane restriction on social vehicles can be clearly observed.

(2) Full-time bus lanes: For a direct comparison, we selected weekdays and weekends with the same period every day.

Statistical methods:

For comparative analysis, the number of bus-only lane vehicles and social vehicles and the number of passengers in each lane during the selected time were counted separately.

Statistical methods for social vehicle passenger flow: With the average social vehicle capacity p, the number n of social vehicles passing the roadway during the counted fixed period was multiplied to derive the passenger flow CP of the social vehicle lanes during this period, as shown in formula 1.

$$C_p = p \times n \qquad (1)$$

Bus passenger count method: We used the video to obtain the serial number from the rear end of a bus. Then, we used the bus live data platform to find the bus recorded in our video and obtain the passenger capacity of this bus at that time cin. n represents the total buses counted, which can be added to obtain the passenger flow of the bus lane CB, as shown in formula 2

$$C_B = c_{i1} + c_{i2} + c_{i3} + ... + c_{in} \qquad (2)$$

Results

Average passenger capacity of social vehicles:

A summary of the collection results for person sampling is shown in Table 2.

Table 2: Shows that the average passenger capacity of social vehicles during the data collection period of this study is 1.7 passengers.

Sequence of sample	Average vehicle occupancy (each sample)
1	1.66
2	1.98
3	1.6
4	1.87
5	1.43
6	1.59
7	1.78
Total average	1.701249

Bus live data:

The passenger information of each bus during the data collection period was queried from the live data website for statistics. The vehicles in the bus lane include special vehicles, such as ambulances, engineering rescue vehicles, and police cars. The number of passengers in such vehicles was calculated according to the average passenger capacity of social vehicles. In addition, many shuttle buses from different companies also take the bus lanes. However, the number of passengers is unavailable on the Bus Big Data website. The number of passengers on such shuttles was calculated based on 25 passengers/vehicle according to the general experience. The results of the bus lane statistics are summarized in Table 3.

Table 3: Bus Lane summary

Sampling site	Date	Period of filming	Number of vehicles	Bus route	Number of passengers
W.3rd ring road N. Huayuan bridge overpass	Dec.29	In restriction 17：30-17：35	2	394、300k	17
	Dec.30	In restriction 17：30-17：35	4	300 300k 394 74	154
	Dec.31	In restriction 17：30-17：35	6	300k、74、394	170
N.3rd ring road Dazhongsi overpass	Dec.31	In restriction 17：50-18：10	4	300、300k、302	113
N.3rd ring road Jimen bridge overpass	Dec.31	In restriction 18：40-19：00	17	300,694,921,300k,671,387,302	232
N. 3rd ring road Sanyimiao overpass	Dec.31	Before restriction 15：30-15：45	3	300、300k	97
G6 Beishatan overpass	Dec.29	In restriction 8：53-8：58	23	345k 328 407 670 885 886 919	664
		After restriction 9：02-9：07	2	315 345	67
	Dec.30	In restriction 8：53-8：58	21	345k 328 407 670 885 886 919	655
		After restriction 9：02-9：07	4	315,670,345k	76
	Dec.31	In restriction 8：53-8：58	17	345k 328 407 670 885 886 919	536
		After restriction 9：02-9：07	5	345,885 670	170
Wanquanhe road, xiyuan, overpass	Dec.30	In restriction 17：15-17：30	2	Shuttle bus，362	56
	Dec.31	In restriction 17：00-17：15	4	651、362	99
Wanquanhe road, Daoxiangyuan, overpass	Dec.30	In restriction 17：00-17：15	0	-	-
	Dec.31	In restriction 17：15-17：30	0	-	-
G4 lugou Bridge overpass	Dec.29	In restriction 17：02-17：07	9	321、616、839、917	189
		Before restriction 16：53-16：58	2	321 616	74
	Dec.30	In restriction 17：02-17：07	8	321、616、839、917	266
		Before restriction 16：53-16：58	4	321、616、839、917	163
	Dec.31	In restriction 17：02-17：07	9	321、616、839、917	163
		Before restriction 16：53-16：58		839 321	36
	Dec.26	Weekend 9：30-9：36	3	BRT4	60
Fushi road, Jin yuan bridge, overpass.	Dec.29	Weekday 9：30-9：36	4	BRT4	80
	Dec.30	Weekday 9：30-9：36	2	BRT4	40
	Dec.31	Weekday 9：30-9：36	4	BRT4	80
	Jan.2	Holidays 9：30-9：36	2	BRT4	40

Social vehicle lane statistics:

The number of social vehicles was counted from the videos taken at different stations and other times. Social vehicles include private cars and taxis. The results of the social lane statistics are shown in Table 4.

Table 4: Summary of social vehicle lanes.

Sampling site	Date	Period of filming	Number of private cars	Number of passengers
W.3rd ring road N. Huayuan bridge overpass	Dec.29	In restriction 17：30-17：35	338	575
	Dec.30	In restriction 17：30-17：35	396	673
	Dec.31	In restriction 17：30-17：35	44	75
N.3rd ring road Dazhongsi overpass	Dec.31	In restriction 17：50-18：10	367	624
N.3rd ring road Jimen bridge overpass	Dec.31	In restriction 18：40-19：00	389	662
N. 3rd ring road Sanyimiao overpass	Dec.31	Before restriction 15：30-15：45	527	896
G6 Beishatan overpass	Dec.29	In restriction 8：53-8：58	124	211
		After restriction 9：02-9：07	110	187
	Dec.30	In restriction 8：53-8：58	105	179
		After restriction 9：02-9：07	127	216
	Dec.31	In restriction 8：53-8：58	251	425
		After restriction 9：02-9：07	376	640
Wanquanhe road, xiyuan, overpass	Dec.30	In restriction 17：15-17：30	536	911
	Dec.31	In restriction 17：00-17：15	584	993
Wanquanhe road,Daoxiangyuan, overpass	Dec.30	In restriction 17：00-17：15	433	736
	Dec.31	In restriction 17：15-17：30	496	846
G4 lugou Bridge overpass	Dec.29	In restriction 17：02-17：07	174	296
		Before restriction 16：53-16：58	347	590
	Dec.30	In restriction 17：02-17：07	99	168
		Before restriction 16：53-16：58	397	675
	Dec.31	In restriction 17：02-17：07	165	280
		Before restriction 16：53-16：58	365	620
Fushi road, East Jin yuan bridge, overpass	Dec.26	Weekend 9：30-9：36	179	304
	Dec.29	Weekday 9：30-9：36	230	391
	Dec.30	Weekend 9：30-9：36	256	435
	Dec.31	Weekday 9：30-9：36	287	488
	Jan.2	Holiday 9：30-9：36	204	347

Comparative analysis:

The following results were obtained by comparing the obtained statistics of the number of vehicles and the number of passages at each station at different times (Tables 3 and 4).

-G6 Expressway:

A statistical comparison chart can be obtained using the collection date as the horizontal axis and the number of vehicles or people passing during the collection period as the vertical axis. The total number of people passing in all lanes during the restriction period (8:53–8:58 a.m.) and after the restriction period (9:02–9:07 a.m.) were compared, as shown in Figure 8. The number of people passing in the bus-only lane and that in the social vehicle lane during the restriction period (8:53–8:58 a.m.) were also compared, as shown in Figure 9.

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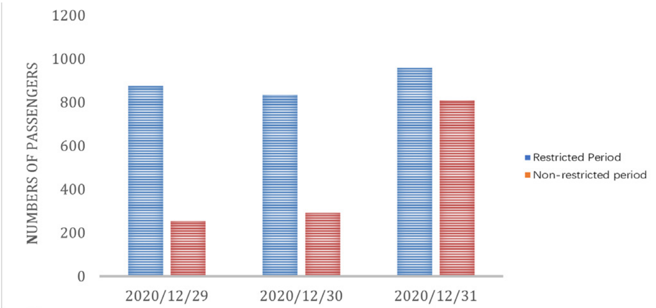

Figure 8: Total Number of Passengers in Restricted and Unrestricted Periods

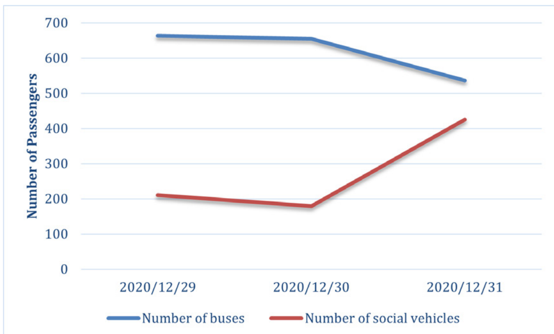

Figure 9: Number of vehicles passed during the recorded period

-West Third Ring Garden Bridge:

The number of people passing in the bus-only lane and the social vehicle lane during the restricted hours in the evening (17:30–17:35) was counted every day for three days, as shown in Figure 10.

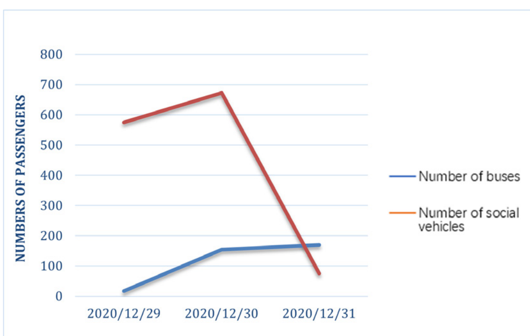

Figure 10: The number of people passing in Garden Bridge North during the restricted period

A total of 338 other vehicles traveled through the social vehicle lanes on December 29. The total number of buses traveling through the bus-only lane was 2, and the total number of shuttle buses traveling through the bus lane was 8. On December 31, 44 vehicles traveled through the social vehicle lanes (traveling under congestion). The total number of buses traveling through the bus lane was 6. Approximately 75 people passed using minivans. The number of people who passed the bus lane was more than that who passed the social lane. The number of people passing using cars on December 31 was considerably lower than that of people passing using cars on December 29 because of road congestion. The number of people passing in the bus lane under congestion was higher than those passing in the uncongested condition. This finding indicates that the bus lanes play a negative role during congested hours.

-North Third Ring Road Dazhongsi, North Third Ring Road Sanyimiao, and North Third Ring Road Jimen Bridge East:

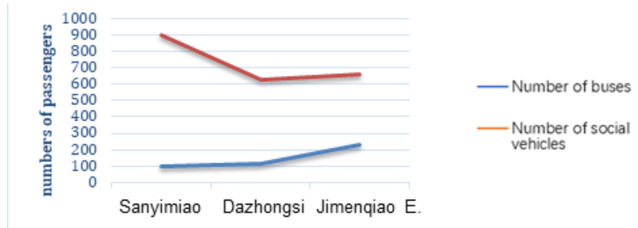

Figure 11: The number of people in the North Third Ring Road site during traffic restrictions

Overall, the number of social vehicle passers in the three sampling sites on the North Third Ring was higher than the number of bus-only lane passers during the evening peak restricted hours in the bus-only lane, with low utilization of the bus-only lane. The number of people passing by cars in Dazhongsi on the North Third Ring Road was less than the number of people passing by cars in Sanyimiao on the North Third Ring Road at different times of the day.

-Wanquanhe Road Xiyuan Bridge:

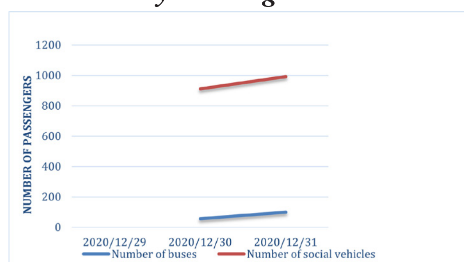

Figure 12: Number of people passing during the restricted period on Wanquanhe Road Xiyuan

On December 30, 536 other vehicles drove through the social vehicle lanes; one bus drove through the bus lane, and one shuttle bus drove through the lane. A total of 584 vehicles drove through the social vehicle lanes on December 31, and four buses drove through the bus lane. The utilization rate of the bus lane at Wanquanhe Road Xiyuan is very low.

-Wanquanhe Road Daoxiangyuan Bridge:

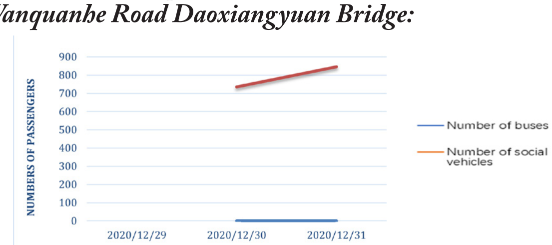

Figure 13: The number of people passing during the restricted period on Wanquanhe Road Daoxiangyuan

On December 30, 97 (before the restriction) + 336 (after the restriction) vehicles traveled through the social vehicle lanes, and the total number of buses traveling through the bus lane was 0. Regarding the number of people, 164 people passed using cars before the restriction, and 571 people passed after the restriction. Moreover, 0 people passed using buses. On December 31, 496 vehicles traveled through the social vehicle lanes, and the total number of buses traveling through the bus lane was 0. Regarding the number of people, 843 people passed using cars, and 0 people passed using buses. The main road at Wanquanhe Road Daoxiangyuan has a bus lane. However, the bus stop is located on the side road; thus, no buses passed through the main road at this site, resulting in bus lane statistics of 0. Therefore, the bus lane in the Wanquanhe Road Daoxiangyuan area is redundant and has no value for use.

-G4 Expressway Lugouqiao:

The results of the enabled (17:02–17:07) and not enabled (16:53–16:58) periods for the bus lane were compared, as shown in Figure 9. The number of people passing in the bus lane and the social vehicle lane during the restricted period (17:02–17:07) was compared, as shown in Figure 14.

Figure 14: Number of Passengers during the Restricted and Unrestricted Periods

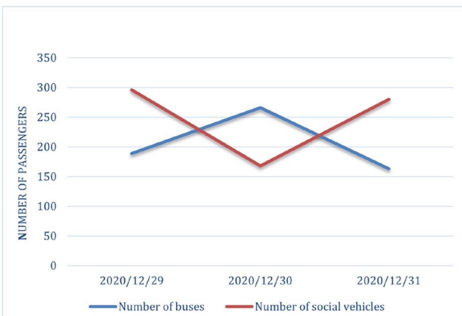

Figure 15: The number of people on the G4 Expressway during bus traffic restrictions

On December 29, 99 vehicles traveled through the social vehicle lanes (under traffic jams), and the total number of buses traveling through the bus lane was 9. On December 31, 365 other vehicles traveled through the social vehicle lanes, and the total number of buses traveling through the bus lane was 9. The comparison shows that the bus lane was set up, allowing the buses to pass smoothly. The bus lane on Lugouqiao of the G4 Expressway was highly utilized. However, Figure 15 shows that the overall utilization rate decreased as the total amount of road traffic decreased because of the bus lane restriction and the inaccessibility of social vehicles.

-Fushi Road east of Jinyuan Bridge:

Fushi Road is an all-day bus lane. The number of people passing in the bus lane and the social vehicle lane on weekdays and weekends was compared, as shown in Figure 16.

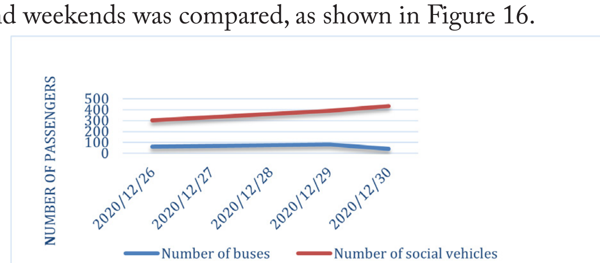

Figure 16: The number of people passing through the bus lane on Fushi Road.

On December 26, 230 vehicles traveled through the social vehicle lanes, and the total number of buses traveling through the bus lane was 3. The bus traveling through the bus lane was BRT No. 4. Regarding the number of people, no accurate data were recorded for BRT No. 4 because the bus did not use the card machine, but crowding was observed. Approximately 20 people or fewer passed on the BRT No.4, thus, 60 people passed using BRT No. 4, and approximately 391 passages traveled by cars. On December 31, 175 social vehicles drove through the social vehicle lanes. The total number of buses traveling through the bus lane was 2. Concerning the headcount, 300 people passed using cars, and 40 passed using BRT No. 4.

The data were integrated and compared. The results indicate that only BTR No. 4 passed through the bus lane on weekends or weekdays. From 9:00 a.m. to 10:00 a.m. during weekends and weekdays, the number of buses and social vehicles has no considerable difference. However, BRT vehicles are scarce, and no other buses can use the Bus Lane, thereby decreasing the utilization of the Fushi Road and affecting social vehicle traffic.

Proposal on optimizing the utilization rate of bus lanes in Beijing:

The following recommendations are based on the results of this study listed above.

Proposal 1. Check the validity of bus-only lanes on the main roads in Beijing. The Municipal Transportation Committee should take the lead and cooperate with relevant departments, such as the road management department, road planning department, bus companies, etc., to scientifically set the restricted sections and time periods of bus lanes by using the camera monitoring data on the road and the big data of bus websites for joint evaluation.

Proposal 2. Changing some bus-only lanes with low utilization to bus priority lanes which the range of vehicles allowed to pass can be further expanded, such as vehicles with more than seven seats, taxis, and electric vehicles with an easily identifiable appearance.

Proposal 3. Canceling the traffic restrictions on bus lanes on weekends and holidays in Beijing and opening the bus lanes for social vehicles.

Conclusions

From Reference 11, we know that without considering other factors and from the perspective of reducing road resource occupation, bus lanes are appropriate only if the number of buses traveling in one direction per hour is greater than 52 (each carrying an average of 50 passengers).[11]

The results of this study show that the utilization rates of bus lanes in Beijing are not the same. Most bus lanes have less than 52 buses in the morning and evening peak hours. Thus, the utilization rate is relatively low. Fushi Road, Wanquanhe Road, and the Third Ring Road bus lanes have low utilization rates. The bus lane utilization rates of the G4 Expressway in the evening peak and the G6 Expressway in the morning peak are high. However, the statistical results of G4 show that the total number of people passing through the road during the restricted hours of the bus lane is lower than that during the nonrestricted hours. This finding indicates that the overall effi-

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ciency of the road is affected by the opening of the bus lane. However, the opposite result is obtained for the G6 Expressway. The number of people passing on the road during the enabled hours for the bus-only lane is greater than that during the non-enabled hours. This finding indicates that many people take the bus as a commuting method.

The locations sampled in this study are locations with high-ground bus traffic. The sampling time is the winter season when buses depart frequently. The utilization rates of bus lanes in other sections of Beijing and other seasons are possibly even lower than those in the chosen locations and sampling time in the present study.

The following shortcomings and areas for improvement exist in the methodology and results of this study.

(1) The data collection and analysis show that the number of vehicles passing under different road conditions is not the same. In this research process, the road conditions on the West Third Ring Road and the North Third Ring Road differ significantly on different dates. The number of samples should be increased to evaluate the actual effectiveness of bus lane utilization.

(2) The data collection for this study was conducted at the end of December and the beginning of January, the coldest season in Beijing. The outdoor flyover collection in winter had a tremendous impact. It also prevented long sampling periods, resulting in few samples and short periods and leading to extreme study results. A follow-up study to extend the sampling time to 1 hour or more can avoid the occurrence of too many vehicles or vehicles passing by chance.

(3) The efficiency of lane use and vehicle speed analysis should be an essential indicators. However, this study did not consider the vehicle speed factor because no special equipment can be used to collect its data.

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Thanks to the CPPCC, who made it one of the top 100 best proposals for 2021. The proposal received much attention, and the government is now taking action by changing from bus-only lanes to bus-priority lanes.

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Authors

Fangyu Shi is greatly interested in urban environments. His everyday experience of being stuck in traffic jams led him to assemble a team in his school to research the effectiveness of bus lanes in Beijing. He drafted the proposal on optimizing the bus lanes utilization and submitted it to the government.