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Original Research Paper

Effects of odd–even traffic restriction on travel speed and traffic volume: Evidence from Beijing Olympic Games

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ARTICLE INFO

Article history:
Available online 13 January 2016

Keywords:
Traffic demand management
Traffic restriction policy
Comparative analysis
Traffic detection system

ABSTRACT

This paper reports the effects of using an "odd and even" traffic restriction policy in Beijing during the 2008 Olympic Games. Based on data from 529 traffic detectors on the expressway network and some main arterials in Beijing, China, a comparative analysis has been carried out on the following parameters: the total traffic volume within the expressway network, the total traffic volume on different ring expressways, the traffic volume and speed of a freeway segment, and an arterial street before and after the implementation of the traffic restriction policy. The results show that during the traffic restriction period, although more than 50% of vehicles were forbidden to travel in Beijing, the traffic volume was only reduced by 20%–40% while the travel speed had been increased by 10%–20%. This suggests that such traffic restriction policy may be an effective short-term management measure in dealing with increased transportation demand and congestion during major events, such as the Olympic Games. Results also indicate that vehicle travel demand does not decrease with the same proportion as the total vehicles forbidden, at least for the expressway and main arterials in a city.

1. Introduction

Given China's rapid socioeconomic development and urbanization, total operating vehicles growth during the past decade has risen quickly, with an average annual rate (AAR) over 10% in cities, especially for the number of private vehicles, which has increased from 3.58 million in 1997 to 28.76 million in 2007 (SSB, 2008). In big cities such as Beijing, the rate of vehicle ownership rises even more sharply. The latest government statistics show that, by the end of Dec., 2008, Beijing has approximately 3.5 million vehicles, compared to just 1 million in Feb., 1997. Additionally, about 1000 new vehicles hit the road every day (date collected from Beijing Traffic

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Peer review under responsibility of Periodical Offices of Chang'an University.
http://dx.doi.org/10.1016/j.jtte.2016.01.002

Management Bureau). Understandably, traffic congestion in Beijing has become increasingly severe over the last decade.

The 2008 Beijing Summer Olympic Games from Aug. 8 to Aug. 24. represent a significant international event that took place in the People's Republic of China. As a mega-event, the Summer Olympic Games also represented a world-wide transportation challenge. The unique characteristics of travel demand for such a special event posed great challenges to the Olympic transportation system managers.

To promote a transportation system ensuring reliable, effective, and safe conditions during international mega-events, host cities usually establish an integrated transportation strategy, that mainly includes the following (Bovy, 2006):

(1) Transportation facilities expansion, including the establishment of an Athletes Bus Network (Minis et al., 2006), expansion of subway and bus network, expansion of highway and railway networks, etc.
(2) Intelligent transportation systems, including traffic management and traveler Information system (Glazer and Cruz, 2003; Amodei et al., 1996), incident response management system, traffic management center, road/weather information system, etc. (Njord, 2002).
(3) Travel demand management (TDM), including free park-and-ride and park-and-walk lots, alternate work and delivery schedules for businesses, carpooling and ridesharing incentives, telecommuting, odd–even day vehicle operation schedules, etc. (Lee et al., 2003).

In order to improve the public transportation service and mobility during the 2008 Summer Olympic Games, the Chinese government placed a great deal of investment in new transportation systems to expand its transportation infrastructure network and improve Beijing's traffic management system. The city's capital international airport was expanded to include the new Terminal 3, and the Beijing south railway station was reopened after two years of construction to include the 120 km Beijing–Tianjin Intercity High-speed Rail. As for urban transportation, Beijing's subway network expanded to more than double its original capacity and overall size, and the road network also expanded significantly. In addition, ten intelligent traffic management systems were implemented before the Olympic Games to improve the performance of Beijing's road traffic network, mainly including advanced traffic management and control center, automatic incident detection system, closed-circuit television cameras, advanced area traffic signal control system, transit signal priority system, variable message signs, real-time traffic forecasting system, etc.

Since the 1970's, traffic demand management has become an important element of transportation policy, with the major focus on influencing the individual travel behavior (Ogunsanya, 1984; Meyer, 1999). Over the past 30 years, a variety of TDM measures, such as traffic congestion pricing flexible working hours, telecommuting, carpooling, etc., have been implemented or demonstrated all over the world (Eliasson and Mattsson, 2006; Hensher and Puckett, 2007; Odeck and Brathen., 2008). Implementation of these TDM measures improved road traffic operation conditions by enhancing the use of highly-efficient transportation modes and reducing private car usage. Researchers have investigated the effectiveness of various TDM measures mainly based on questionnaire results (Gärling et al., 2000), theoretic analysis (Nakamura and Kockelman, 2002), and case studies (Lee et al., 2003; Guo et al., 2008; Eliasson et al., 2009).

Lee et al. (2003) reported the influence of alternative driving prohibition using of odd–even numbered private vehicles during 2002 FIFA Korea–Japan Worldcup in Seoul, Korea. Results revealed those during those 15 d, traffic volume decreased by 19.2% on average, and traffic speed increased by 32.1% on average, with 90.5% of vehicles complied with this mandatory driving suspension regulation.

Guo et al. (2008) examined the influence of TDM measures on traffic operation during the Forum on China–Africa Cooperation in Beijing. The study examined the state preference survey data from bus and metro operating companies, as well as data from traffic detectors embedded in the road. The study results revealed that the average vehicle speed increased by 7.4% and 15.6% during morning and evening peak hours respectively.

During the 2008 Summer Olympic Games, traffic demand management strategies were also used to control the flow volume on road network. One strategy involved the temporary rationing of road space based on license plate numbers. Beijing's massive experiment to control traffic flow offered researchers a unique chance to evaluate the study in a urban setting.

Wang et al. (2008) investigated the effects of TDM measures during the 2008 Beijing Olympic Games, during with the traffic flow volume declined by 22.5%, and the average speed during the morning peak period increased by 28.5%. Wen et al. (2008) analyzed operating conditions based on floating car data, and results show that the average speed of the whole road network increased by 26.9% and 22.8% during the morning and the evening peak periods, respectively.

This paper analyzes the effects of the traffic restriction based on the field data from hundreds of traffic detectors in the expressway network and an arterial street operated by Beijing Traffic Management Bureau. Section 2 overviews the traffic restriction policy during the Beijing 2008 Olympic Games, and the data sources are introduced in Section 3. Section 4 analyses the changes of traffic volume and speed in the expressway network and arterial streets. Section 5 discusses the comparative analysis. Finally, Section 6 presents the conclusions along with recommendations concerning the design of future traffic management in Beijing.

2. Traffic restriction policy

The transportation strategies and management measures caused to accommodate the travel demand during the 2008 Beijing Olympic Games, involved several categories. They include transportation infrastructure expansion, traffic demand management, traffic restriction, public transportation system expansion, Olympic traffic reserved system, and more. This paper focuses on the traffic restriction policy and public transportation system expansion. Traffic restriction measures for the Olympic event were only valid from Jul. 1 to Sept. 20, 2008.